Integrated Power Policy

A frame work for people-centric, environment-friendly and sustainable power policy

Shankar Sharma

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Dedication

This book is dedicated to all those people, flora and fauna which have been impacted adversely by the wrong policies in Power Sector. It is hoped that the efforts of many people behind this book will be able to minimse such impacts in future.

Foreword by Admiral L Ramdas

For the first time in many years, the Planning Commission decided to work out an integrated Power Policy in 2005 and put it on its website for a public debate. It called for views from anyone and everyone, but predictably there was no announcement of this in the electronic media at the time, which could have enlarged the discussion and debate. Many experts, including Mr. Shankar Sharma, a power policy analyst, had forwarded many suggestions to the Planning Commission. As expected, the Planning Commission made very little if any corrections to their original draft policy. The result was the emergence of a policy in 2006 which was primarily theoretical and which only addressed the financial, economic and technical aspects of the Energy projections. It had paid very little if any attention to social and environmental factors which would have been affected by this policy. The numbers and projections therefore made were completely out of sync with exclusively Indian needs. These were originally worked out keeping in mind international standards. The projections of the futuristic requirement of energy, primarily electricity, was based on the consumption figure of 2000MW per Indian, per annum.

As of now, over forty percent Indians, (which amounts to nearly 400 million people who live below the poverty line) who live without any form of electric power. We are already aware that we lose about forty percent of our total electric power generated due to transmission and distribution losses.

In Mr. Sharma's view, a figure of 1000 kWH of electricity per person, per annum, would be more than adequate to provide the basic needs of lights, fans, and a TV connection for all our people. Mr. Sharma also believes that suitable measures, strictly applied to curtail the T&D losses, including inefficient management of power stations, would more or less give us an additional 45% of electricity, even with the present installed capacity.

Mr. Sharma has eloquently argued, quoting facts and figures, duly supported by documents in the various appendices to this

book, that India needs to evolve a holistic and integrated policy approach for providing electricity for all by the year 2032. Amongst the many factors he has highlighted are :

- Need for a correct assessment of demand based on a 1,000kWH per Indian per annum
- More efficient operations to cut down production, transmission and distribution losses.
- The rule for policy projections and decisions should be based on the cost benefit analysis of all resources – both renewable and conventional – for example coal, nuclear, etc.
- The emissions of carbon by conventional coal based power plants keeping in mind the adverse contribution of carbon to global warming.
- Nuclear power plants on the other hand, while appearing to be clean and green, have huge adverse impacts on both ecology as well as health and safety. The hidden costs of nuclear fuel, all of which has to be imported, the disposal of nuclear waste, and the final disposal of nuclear power plants at the end of their life cycle have been conveniently ignored. These when assessed holistically from a cost benefit analysis point of view, will automatically provide the answers for arriving at the right decision for the choice of future energy sources.

The book makes a strong case for opting to use renewable sources like solar, wind, hydel and bio-mass to meet India's electricity requirements as suggested at the figure of 1000 kWH per person/per annum as a do-able proposition. This will provide for our country a Carbon Free and a Nuclear Free energy strategy to meet our projected requirements by 2032. Needless to say, all of the above will require a great deal of commitment, especially by the Government, the Planning commission and others, including the Corporate Houses. Education and awareness building for a policy as enunciated above will be the key element of the way ahead.

Altogether this work is an outstanding and timely analysis meriting a read by all those interested in the energy needs of India of the future. We can and must move forward to use the abundant renewable resources at our command to make our country self sufficient for our energy needs in the time frame we have selected. It is a simple and effective road map to lift the more than 400 million fellow Indians out of the Poverty trap.

From Dr. E. A. S. Sarma
The Former Union Power Secretary

The Indian planners have difficult choices to make, in terms of both the development paradigm they should adopt and the energy trajectory they should follow during the coming decades.

The successive Five Year Plans of the country have accorded the highest importance to the need for "inclusive" development as the central theme of planning. It is ironic that the projects and the programmes undertaken in the name of development have rarely come up in consultation with the people and have rarely benefitted the local communities.

According to a recent report of UN Working Group on Human Rights, India has the largest number of persons displaced by development projects in the world. The report placed the number at 65 million since Independence. In other words, on the average, the so-called development projects in the country displaced one million persons every year. The magnitude of the annual displacement has been higher than ever for the last ten to twelve years as a result of the large number of SEZs, power projects, mining projects, steel plants, pharma complexes, luxury housing schemes and so on , that have come up in different parts of the country. The costs of social disruption, human trauma and environmental degradation that such projects have caused have been enormous. The social costs of it have not been factored into the markets from which the developers have earned windfall profits. Those who advocate a growth-driven development paradigm are either blissfully ignorant of this or deliberately indifferent.

In the case of coal-based power projects, if the climate concern is of paramount importance, the human displacement concern is equally daunting and of greater urgency. This is a concern that applies equally to all large centralised electricity generation projects. In the case of nuclear power, there is the added dimension of catastrophic accident risk combined with the waste disposal challenge and the day-to-day exposure of people to low-intensity radiation, the perils of which are not fully understood. It is unfortunate that the government, unmindful of these concerns, should aggressively proceed on a supply-driven path without even respecting the law of the land at times. The energy planners should wake up to this challenge and restore rationality into the energy development approach.

The energy planners are left with a limited portfolio of choices ranging from demand management to efficiency improvements down the energy supply line and progressively replacing non-renewables with renewables. In the long run, there is no escape from reshaping our lifestyles to adopt a development model including an energy trajectory that minimses the per capita useful energy requirement and a development model that is based on minmal use of resources and displacement.

In addressing these basic concerns and balancing the mutually conflicting objectives, Mr. Shankar Sharma has done a commendable job in this book to come up with a possible energy development trajectory on which India should move from now onwards. Unlike the numerous official studies, including the Integrated Energy Policy report of Planning Commission, Dr. Sharma's book revolves around the need to generate a people-centric model of energy development. The energy planners of the country should take cognizance of the serious concerns he has listed out and initiate a discussion with the civil society in a truly democratic manner. Such a discussion alone will impart credibility to the process of planning energy development.

Preface by the author

Energy has become a crucial part of the modern society, so much so that per capita availability of energy is considered as an indicator of Human Development. However, the social, economic and environmental impacts of demand/supply of energy are so great that only a holistic and objective consideration of all the related issues from the society's perspective will enable the formulation of a sustainable and effective national energy policy. Electrical power sector, because of its essential nature to the modern lifestyle, has become a contentious part of our economy due to multifarious crises facing it. A credible power policy, keeping in view the legitimate demand in the next 25-30 years and keeping its long term sustainability in focus, has become critically important to ensure all-round development of different sections of our society, and to discharge our obligations to the future generations. To enable such a policy adequate deliberations at various levels of our society involving all shades of opinion are of critical importance. Effective participation of the civil society in the preparation and implementation of forming a national energy/power policy is hence essential.

In 2005, the Planning Commission of India had set up an "Expert Committee on Integrated Energy Policy" to prepare an Integrated Energy Policy for the country. The draft of such a report was posted on the Planning Commission website, and feedback from the public was invited. Towards the end of 2005, I provided feedback to the committee expressing many serious concerns on the recommendations in the draft policy. The committee finalised its report in August 2006. Though there were some improvements in the final report, the recommendations had many serious concerns to our densely populated and resource constrained communities, and could be seen as inconsistent with the overall welfare goals of our communities.

Over 31 years of experience in power sector in India, New Zealand and Australia in the public & private sector; in developed & developing economies; in highly professional & not so professional environments convinced me that the main recommendations in IEP to increase the production capacity by many folds of the conventional power sources by 2031-32 would lead to enormous problems to the vulnerable sections of our society as well as to the fragile environment. In that regard a

detailed critique on the IEP was prepared and shared with many like minded people. Since 2006 that critique was improved many times on the feedback obtained from like minded people, and on the basis of shades of opinion/events from around the world. The events/news reports/published articles/surveys etc., since 2006, on the vexatious issues on hydro power, coal power and nuclear power, and the developments in the renewable energy sector all lead to support my initial conviction that the ill-conceived and large scale conventional power projects are not in the interest of our communities, and there are many better alternatives to meet the legitimate demand for electricity of our impoverished communities.

My concerns with the past/present policies in the power sector found resonance with many NGOs, which have been working hard to protect the legitimate rights of our impoverished communities and the bio-diversity. These concerns along with credible measures to overcome the power cuts and the deleterious impacts of the ill-managed power sector were presented to policy makers on several occasions: (i) a high level meeting called by the Chief Minister, Karnataka in relation to the agitation against Tadadi UMPP (Bangalore, 20th May, 2006); (ii) presentation to Karnataka Electricity Regulatory Commission (Bangalore, 3rd week Dec 2006); (iii) seminar on Power Sector Reforms organized by Karnataka State Planning Board (Bangalore, 5th May 2007); (iv) high level meeting by the energy minister, (17th June 2008; BESCOM office, Bangalore); (v) a presentation to energy minister, Karnataka on his visit to author's house (Thirthahally, 8th November, 2008); (vi) discussion meeting chaired by the Principal Energy Secretary (Bangalore, 21st June 2010). An open letter to the CM, Karnataka on the power sector issues of the state and which was signed by many leading citizens of the state was published in few news papers of the state on 11th March, 2010. Many articles highlighting the issues of the state's power sector and also the issues at the national level have been/ are being published in the print and electronic media.

It is amazing to know that the successive governments, both at the centre and states, have been ignoring the writing on the wall for decades. For, way back in 1980s, Late Prof. Amulya Kumar Reddy of IISc had highlighted the critical role of high efficiency and Demand Side Management in reducing the need for so many power plants. The official figures for the Transmission and Distribution losses in Karnataka were known to be very high even in 1990s as in the table below. The cavalier attitude of the authorities in such an important aspect of the sector can be noticed in the sudden spurt in losses from 18.6 % to 30.2 % in one year. Inefficiencies at various levels of the power sector

were also known for more than two decades.

Transmission and Distribution (T&D) losses in Karnataka

Year	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02
% Loss	19.00	18.50	18.00	18.60	30.20	38.00	36.50	36.00

(Source: Ministry of Power, Govt. of India)

Many seminars, representations to the state and the central governments; communications to the Chief minister, Prime Minister, Environment minister, Planning Commission, Standing Committee of the Parliament on Energy, Central Electricity Authority, Karnataka Electricity Regulatory Commission have all attempted to draw the attention of the concerned authorities towards the chronic problems prevailing in the power sector, and also to the solutions available.

All these measures did not seem to result in any discernible influence on the concerned authorities/policy makers. The issues in power sector can be seen as getting worse with each passing year as evidenced by the omnipresent power cuts; increasing number of proposals for new power projects; huge inefficiencies at all levels; poor financial status ; blatant political interference; lack of professionalism etc. The ever increasing number of media reports on people's agitations against power projects indicated the growing crises for the society. In this context I was convinced of the need for a detailed study of the past and present policies of the power sector, and also of the recommendations in IEP.

An objective review of the relevant recommendations in the Integrated Energy Policy (IEP), as developed by Planning Commission of India, has been taken as the basis for discussions in this book, and major issues of concern to the society w.r.t the power sector are considered. Only the issues relevant to electrical power sector are discussed in the book though the original critique on IEP contained discussions on other energy related issues also. The ever increasing concerns on Global Warming/Climate Change, various reports by Inter Governmental Panel on Climate Change (IPCC), the media reports on the impacts of Global Warming, the large number of agitations across the country against large size power projects, the debate on nuclear power policy, the chronic power cuts faced by most of the communities etc. all demand a holistic look at the issues of power sector in the country. The fact that about 400 Million people in our country have no access to electricity (as per 2001 census) despite massive investment in the power sector since independence is a clear pointer to the need for a

thorough review of the past policies.

It is not the objective of the book to provide detailed analysis of electrical engineering practices, as may be expected in an electrical engineering textbook. The book aims at covering larger issues at policy and institutional level in order to facilitate informed decision making towards the ultimate goal of overall welfare of our communities through equitable access to electricity for all. The primary objectives of this book are: (i) to discuss as to what constitutes the true electrical power demand of our communities; (ii) to discuss the social, economic and environmental impacts of various conventional forms of producing electricity in the Indian context; (iii) to discuss India's potential in various forms of energy resources w.r.t its natural limitations; (iv) to discuss the costs & benefits to our society of conventional power sources, and suitable alternatives; and (v) to recommend a set of credible action plans/policies.

In the context of growing number of agitations because of the issues associated with people's displacement, impact on environment, fast depleting natural resources, ever growing inequalities, global warming etc. the need for active involvement of various sections of the society cannot be ignored any more. My own association with some people involved in such agitations in different parts of the country convinced me beyond doubt that a paradigm shift to the way we view the demand /supply of electricity was urgently required to ensure social harmony and in choosing an acceptable level of ecological health. A visit to Washington DC and the state of West Virginia in September 2011 on an invitation from Sierra Club, USA indicated that the opposition to coal mining/power projects is not unique to India, but it is prevailing in all countries relying on coal as a source of power/revenue.

There is a need to consider the legitimate demand for energy / electricity in the correct context of greater needs of the society such as clean air, water and healthy food, and the inescapable limits of the nature in supporting such a demand. In this regard it becomes obvious that the conservation and enhancement of our environment and bio-diversity must not be compromised in order to meet the unabated demand for energy / electricity. Within the energy / electricity sector, there is a critical need to: clearly differentiate our needs from wants/luxuries; recognize the fact that fossil fuels are fast running out; focus on improving the energy efficiency to international best practice levels.

The professionalism needed to adopt the international best practice level efficiencies also can no longer be ignored in various segments of the power sector. Without being supported

through an objective 'Costs and Benefits Analysis' (CBA) from a societal perspective, no new power project can be accepted as essential. The last man on the street OR the most vulnerable sections of the society should be at the centre of our power policy to enable adequate human development of the entire society, instead of focusing on GDP centred growth. Sadly such a constitutional requirement seems to have been ignored in our past practices. The book has focused on the need for such an inclusive growth. It is prepared with the objective of providing a credible information base for those interested to participate in the well informed decision making processes in the power sector.

In the initial stages of the drafting of this book two major issues engaged my specific attention: who should be the targeted readers of the book, and what should be the overall theme/tone of the book. The question whether the efforts in bringing out this book should be recognised as a technical book or a treatise or a study was deliberated on. There was even a suggestion that many of the statements/conclusions in the book may be termed as rhetoric, and that the discussions may be termed as in a 'campaign mode'. One critic of the draft even thought that some readers may view the author as 'anti-dam', 'anti-coal, and 'anti-nuclear'. In this context, it was felt that such branding by a miniscule section of the society as vastly preferable as opposed to being termed as 'anti-people' and 'anti-environment' by the entire humanity. I decided to leave the decision to the wisdom of the readers since the actual discussions in the book can be seen as multi-disciplinary as they were based on technical, economic, environmental, social, intergenerational, ethical, constitutional, and cultural & heritage issues as experienced/read/studied in my own life. I felt strongly compelled to portray the issues as I see it from the Civil Society's perspective, even if a small section of the intelligentsia find them not strictly adhering to the conventional subtleties of a classical style technical book.

There is no claim that this book covers exhaustively all the issues of electrical power sector. To do so would require a team of people and few volumes of such books. The basic objective is to draw the attention of all the concerned/interested people to the chronic problems being faced by our communities and environment because of the wrong policies/practices in electrical power sector, and to recommend a set of possible solutions. Main references in the book are numbered and provided at the end of each chapter. A large number of additional reference materials have also been indicated to enable the interested readers to read further. Tables of information, few charts and photographs to provide proper perspective are added at relevant places in the book. Numbered

annexures are referred to at appropriate places, and are shown at the end of the book.

The book is hoped to be of help to the students of & professionals in power sector, including the policy makers, and to all those who are interested in making our power sector highly efficient and accountable to the Civil Society. It is sincerely hoped that this book will help in: wider dissemination of various issues associated with the country's power sector; enables effective & informed debate at the national level on future direction for the power sector; and leads to a credible, people friendly and environmental friendly power policy for the country.

Contents

Common terminologies used 15

Executive Summary for the policy Makers 17

Chapter 1: Introduction 27

Chapter 2: Realistic Electricity Demand projection 29

Chapter 3: Heavy reliance on coal power 58

Chapter 4: Large hydro power capacity addition 89

Chapter 5: Ambitious targets for nuclear power 113

Chapter 6: Environmental and Social Impacts 137

Chapter 7: Role of renewables in future 159

Chapter 8: Other Issues of concern to society in Power sector 177

Chapter 9: Holistic view of overall welfare of the society 182

Chapter 10: The Way Forward 189

Chapter 11: Power sector scenario by 2032 & beyond 211

Chapter 12: Power Infrastructure for the Future 220

Chapter 13: A Case study on Karnataka 229

Chapter 14: Action Plan for a sustainable power policy 242

Annexures 1 to 19 249

Common terminologies used in the book

AT&C loss	Aggregate Technical & Commercial loss
BU	Billion Units = 1,000 MU = 1 Tera Watt Hour = 1 TWH
CAGR	Compounded Annual Growth Rate
CBA	Costs and Benefits Analysis
CEA	Central Electricity Authority; technical wing of Ministry of Power (MoP)
CH_4	Methane gas
CO_2	Carbon Di-oxide gas
CSP	Concentrated Solar Power
DSM	Demand side Management
EAC	Expert Appraisal Committee (under Ministry of Environment & Forests)
EHV	Extra High Voltage
EIA	Environmental Impact Assessment
EPS	Electric Power Survey; (Such as 18^{th} EPS)
EJ/Y	Extra Joules per year (A large unite of energy)
GDP	Gross Domestic Product
GHG	Green House Gas
GNP	Gross National Product
Grid	Integrated power network
GWH	Giga Watt Hour = 1,000 MWH = 1 MU
HDI	Human Development Index
HV	High Voltage (generally associated with voltage above 33, 000 Volts)
Hydro Power	Hydro electric power (hydel power)
kW	Kilo Watt : A common unit of electrical power
	= 1,000 Watts = total power of 10 incandescent bulbs of 100 Watt power capacity each
kWH	kilo Watt Hour = 1 Unit: A common unit of electrical energy (power consumed in a given period)
	1 kWH = 1 kW of electrical power used continuously for 1 hour
MNRE	Ministry of New & Renewable Energy

MoEF	Ministry of Environment & Forests
MoP	Ministry of Power
Mt	Metric Tonne
Mtoe	Million Tons of Oil Equivalents
MU	Million Units: Another unit of electricity consumed in a given period = 1,000 MWH = 1 GWH
MVAR	Mega Volt Ampere (Reactive): A technical term used along with electrical power, MW.
MW	Mega Watt = 1,000 kW = Enough power to electrify about 4,000 Indian rural houses
MWH	Mega Watt Hour = 1000 kWH; (another common unit of electrical energy)
O&M	Operation & Maintenance
Peak Demand	Demand for electrical power at the time in a day when most sections of the society use electrical appliances at the same time. This generally occurs in early morning (between 6 AM to 9 AM) and evening (between 6 PM to 9 PM)
Per capita	per person per year: an average indicator at the national/state level (Such as per capita electricity = total electricity produced/conumed in 1 year DIVIDED by the total population in the country)
PLF	Plant Load Factor: a measure of the utilization of the capacity of a power plant
REDD	Reducing Emissions from Deforestation and Forest Degradation
RE systems	Renewable Energy Systems
R, M&U	Renovation, Modernisation & Upgradation
SO_2	Sulphur di Oxide
Solar PV Panels	Solar Photo Voltaic panels (SPV panels)
SVC	Static VAR Compensator (voltage management mechanism)
T&D loss	Transmission & Distribution loss
TPD	Tons Per Day
UHV	Ultra High Voltage
UMPP	Ultra Mega Power Project; large size coal power project; generally of more than 1,000 MW capacity
UNFCCC	Unite Nations Framework Convention on Climate Change

Executive Summary for the policy Makers

The need for an Integrated Power Policy *(Chapter 1).*

Integrated Energy Policy, as developed by the Planning Commission in 2006, seems to have based its policy recommendations largely on technical, financial and logistical issues, ignoring the hugely important social and environmental aspects of our society. Urgent course corrections are considered essential in order to ensure the true welfare of all sections of our society. Power sector, being a predominant part of the energy policy, needs an integrated approach in order to meet the needs of all sections of our society on a sustainable basis. On the basis of our own experience, since independence, its impact on social, economic and environmental aspects of our society needs an objective and serious consideration. What our society is looking for is not electrical power itself, but the services such as lighting, heating, cooling, motive power etc. from the electrical power. Hence an integrated approach in determining which source of electricity is most suitable for which condition/application at minimum overall cost to the society can be determined only through an Integrated Power Policy approach. The fact that about 40% of our population has had no access to electricity (Census 2001) should remove any doubts about the need for a paradigm shift in our society's approach to the demand/supply of electricity.

The imperative for a realistic Electricity demand projection *(Chapter 2).*

A credible electricity demand projection is critical for the responsible management of power sector. The projection by Integrated Energy Policy (IEP) that the country's electricity production capacity has to increase by five folds (from about 160,000 MW in 2006 to about 800,000 MW by 2032), seem to have been done without considering the associated social and environmental impacts. There is a need for an objective review whether such a large capacity addition based on conventional power sources is in the overall interest of our communities. In this regard whether the true projection of electricity production capacity should be 1,700 BU @ 1,000 kWH per capita by Year 2070, OR 272,000 MW for 4% CAGR by 2031-32 is not as important, as the much needed holistic approach in effectively managing the grid demand for a sustainable supply scenario. Another projection of

electricity demand by 2070 (by a Professor from IIT) on the basis that 2,000 kWH per capita of electricity is very frugal and that it is necessary for the minimum Human Development Index, also cannot be accepted for the above stated reasons. Because, this much per capita electricity in 2070 for the estimated population of 1.5 Billions can mean a huge amount of grid based generating capacity, which can not be in the true interest of our communities and the environment. A critical analysis of what constitutes true electricity demand for our communities may indicate that about 1,000 kWH of per capita electricity should be able to meet all our legitimate electricity demands even in the future years such as 2050 or 2070.

A realistic demand forecast must objectively take into account the social, economic, and environmental issues such as the changing consumption pattern across different sectors of our economy; nature's limit; Global Warming potential of energy consumption; and our obligations to the future generations. A carefully thought out strategy consisting of responsible demand side management and sustainable energy supply options has become imminent for the long term welfare of our communities. In this context the electricity demand projection from the official agencies generally has been found to be exaggerated, because of which a large number of conventional power projects, without due diligence, are being proposed/implemented all over the country with hugely avoidable costs to the society. Keeping in view the limits of the nature in supporting unlimited energy/electricity demand and its implications on our communities, all possible efforts must be made to contain it within manageable levels. India being a tropical country, and having been used to a frugal life-style of our ancestors, our communities will not need high levels of per capita energy/electricity consumption to achieve acceptable levels of human development. Because of the seriously flawed target of aiming to achieve high per capita energy/electricity consumption index, the country must aim to avoid the wasteful life style of the industrialized countries. Instead of projecting future electricity demand with the GDP maximizing paradigm, the country must aim at determining the least amounts of energy/electricity required to eradicate poverty.

Major concerns in continuing with heavy reliance on conventional sources of electricity

*(Chapter 3, 4 & 5)***.**

Enormous increase in the installed power capacity in the country since independence (about 180 times) and centralsied power supply system has not been able to meet the electricity needs of rural India. About 400 Million people are reported to be outside the purview of the electricity Grid even in 2011 putting a big question mark on

the true relevance of such a policy to our country of villages.

Coal, as a fossil fuel, is fast running out, and is encountering a lot of issues such as the ever tightening environmental regulations, the escalating price and decreasing reliability of supply. The popular oppositions around the world to the coal mining and coal power plants are escalating because of the recognition of social, economic, environmental and health issues associated with the mining, transportation and burning of coal. Coal's global warming potential is acknowledged as huge, because of which there are persistent calls for early retirement of coal power plants. India, being one of the largest producers and users of coal, has to address the credible concerns of its teeming millions on all the related issues. Even from technical and financial angles it appears difficult to portray a role for coal in our future energy scenario. In the backdrop of very difficult situation as far as domestic coal supply to the existing power plants, and in the context of hardening global markets, it is also difficult to see any optimism on the coal supply front in the near future. One can expect a lot of stranded assets in coal power generation, along with huge burden to the society, if necessary steps are not taken to rationalize our generation planning strategy.

A holistic approach to the direct/indirect costs to the society associated with the coal power and an objective comparison with other sources of electricity has become critical. The additionally planned coal power capacity of about 700, 000 MW, as reported in various sections of the media, needs rationalization from the perspective of the social, environmental & economic issues, and in the context of Global Warming phenomenon to which coal burning is a major contributor.

Hydro power capacity addition to a large extent (from the present level of about 37,000 MW to 150,000 MW by 2031-32), as recommended by IEP, needs an objective review from the perspective of the true costs to the society, sentiments of the people and intergenerational aspects. All the associated costs and benefits to the nation, and the long term welfare of our communities deserve much more serious attention than has been given so far. The critical importance of a free flowing river to the bio-diversity, and to the communities which are dependent on it cannot be continued to be ignored any longer. To enable such holistic considerations a change in the society's approach is critical: wherein various stake holders are effectively involved in the relevant decision making processes; and the experience of our own people since independence are taken into objective account. The past and present practice of ignoring the costs associated with the all important environment in Techno-economic feasibility studies by CEA should be objectively reviewed.

Nuclear power capacity, which is being proposed to be increased from about 4,800 MW in 2011 to about 63,000 MW in 2032,and to about 250,000 MW by 2050, has also seen increasingly vociferous debate on its true relevance to our society. The impact of a wrong nuclear power policy will be much more severe on our densely populated and ill-prepared communities than that in developed countries. Hence there is an inescapable requirement that various sections of our society should be taken into objective confidence before making any commitment to build additional nuclear power plants. In view of the fact that any unfortunate nuclear accident in our densely populated country can have unimaginable consequences, the Precautionary Principles as enunciated by the World Bio-diversity Convention in our developmental paradigm must be heeded to. An objective analysis of all the related issues on nuclear power, including the experiences from other parts of the world, is critical in arriving at the most appropriate decision for the welfare of the entire society. The true costs to our communities and the benefits from nuclear power plants and all the associated activities such as nuclear material mining, safe levels of radiation even during normal operation of reactors, the catastrophic risks of nuclear accidents (as in the backdrop of Chernobyl and Fukushima events), net energy consumed/produced in the nuclear fuel cycle, the true relevance of nuclear power in the Indian scenario, benign alternatives, and the need to safeguard our communities and the environment from the nuclear wastes etc. must be thoroughly debated at the national level, and a consensus of various sections of our society must be obtained before making any long term investments in the sector.

Importance of Environmental and Social issues *(Chapter 6)***.**

Keeping in proper perspective the mandate of our Constitution, various Acts of our Parliament, the International Conventions for which India is a signatory, and most importantly the society's obligations to its vulnerable sections, it becomes obvious that we need to adopt a paradigm shift so as to make the power sector environmentally friendly, with a high level of responsibility toward the bio-diversity. Global Warming is seen as an existential threat to which the power sector has been a major contributor. Unless urgent course corrections are applied, the power sector's contribution to the destruction of life on this planet will escalate through Global Warming phenomenon. Many of the high profile programmes such as National Mission on Sustainable Habitat; National Water Mission; National Mission for Sustaining the Himalayan Ecosystem; National Mission for a Green India etc. under NAPCC may not have any realistic chance of yielding the

stated results unless the power sector is made environmentally responsible. Our failure to conserve our natural resources and to protect the bio-diversity will threaten the very welfare objective of the GDP centred growth target,

Role of renewables in future *(Chapter 7)***.**

Possibly, there can be no doubt that the future of our country entirely depends on how effectively our society will be able to harness the huge renewable energy potential within the country. At the international level there is increasing level of confidence and advocacy for deploying renewable energy sources. An integrated energy resource management approach, with a carefully designed combination of centralized and decentralised renewable energy sources, is absolutely needed to avail energy security. The renewable energy sources in distributed mode alone has the potential to completely eliminate the energy injustice to our rural population; but not the dependence on external resources such as coal, petroleum and gas as recommended by IEP, or by risky nuclear power. Whereas the costs associated with the renewable energy sources are continuously plunging, such costs in the case of conventional energy sources are escalating. If the externalities associated with conventional energy sources (such as health and environmental costs) are objectively considered, the benefits to our society from renewable energy sources can be seen to be many times more than those with the conventional energy sources. There are already many cases of renewable energy sources meeting the electricity needs of un-electrified villages satisfactorily. Effective deployment of distributed type renewable energy sources such as roof top solar PV panels, small size wind turbines, community based bio-mass plant or CSP type solar power or solar PV panels etc. can revolutionise the power sector scenario in the country, and hence will need serious efforts to harness this potential for the accelerated welfare of our rural communities.

Other Issues of concern to society in Power sector *(Chapter 8)***.**

The continued dependence on imported fuels cannot assure us energy security. Energy Plantations, as recommended by IEP to increase bio-energy, unless carefully managed has the potential to impact the food security. The society cannot continue to ignore the need to identify a definitive year to reach peak use of fossil fuels. IEP recommendation for creating coastal infrastructure for import and use of coal should be carefully reviewed for its overall impacts on the society. Focus should not be only on centralized energy infrastructure, but needs be shifted to distributed power supply systems where the electricity produced is consumed locally.

The continued failure of the constitutionally mandated institutional mechanisms to protect the legitimate interests of various sections of our society should be a major concern. It appears that the unbearable pressure (from the private business houses) associated with the perceived need for large additional power capacities on such administrative ministries, regulatory bodies and agencies has resulted in less than diligent application of the spirit of law to effectively take care of social and environmental issues. There is an urgent need to strengthen the institutional mechanism in order to address the social and environmental issues effectively.

Costs & Benefits Analysis as an effective decision making tool *(Chapter 9)***.**

In order to ensure a holistic view of the overall welfare of the society, the need to make Costs & Benefits Analysis (CBA) as an essential & objective part of the project approval process cannot be ignored any longer. Such a CBA can assist in capturing all the direct and indirect costs and benefits, so as to enable a wider section of the society to get convinced about the real need for a given project. An important aspect of such a CBA is that it should involve consideration of all feasible alternatives in the pursuit of a given objective; and that it should involve transparent public consultations. Such a mechanism, if used effectively, can clearly differentiate between a high cost project and a high benefit project from society's perspective. For example: in the case of providing electricity to an un-electrified village such a mechanism can clearly establish as to which option (extending the nearby grid supply OR installing roof top solar PV systems OR a community based bio-energy unit etc.) amongst those suitable to that village is most beneficial to the community/society.

The Way Forward *(Chapter 10)***.**

Only through an integrated energy resource management approach it is feasible to meet the legitimated demand for electricity of all sections of our society on a sustainable basis. The combined loss to the nation because of the prevailing inefficiency in the power sector, as per 13th Finance Commission, is expected to reach about Rs. 125,000 Crores a year by 2015. Large additions to power production capacity alone will not solve the problems, as has been experienced during the last 6 decades. Highest possible efficiency, minimum wastages, responsible usage, and wide spread usage of renewable energy sources should be the basis of integrated energy resource management approach. In view of the fact that as much as 35 to 40% of the demand existing on the interconnected power network can be reduced by efficiency improvement measures alone, the STATE has to consider such measures as the first option to bridge the gap between demand and supply. These measures are like low

hanging fruits with many perpetual benefits: very low costs, small gestation periods, low or negligible impact on the environment etc. They should be priority number 1.

A massive campaign on rain water harvesting, ground water recharging and powering agricultural pump sets through solar panels should be priority number 2. The effective cost to the society of these measures will be negligible when compared to the overall and perpetual benefits from them.

The need to keep at the centre of our focus the overall costs and benefits to the society of any power supply option need no special emphasis. Effective public consultation will enable adoption of the most suitable power supply alternative. The overall objective should be to eradicate poverty as a fundamental goal while minimizing the impacts of the environment.

Power sector scenario by 2032 & beyond *(Chapter 11)*.

The huge scope available in efficiency improvement in the power sector clearly indicates that in reality there has been no need for power cuts. An objective analysis of the true demand and the huge potential available with renewable energy sources will also indicate that the reliance on conventional energy sources can be drastically reduced by 2032, and can even be completely eliminated by 2050. What is needed is the required level of commitment, a holistic approach, and detailed analysis of the electricity demand and potential for renewables in each of the small geographic areas such as revenue districts/talukas. Highest possible efficiency in all segments of the sector; effective demand side management; optimum level of energy conservation; suitable tariff structure; effective usage of renewable energy sources; societal level responsibility in power sector management etc. is needed to make the power sector sustainable, and to meet the expectations of the people.

Power Infrastructure for the Future *(Chapter 12)*.

There can be no doubt that the future infrastructure of the power sector need to be much more efficient, professionally managed, and accountable to the public. Undue political interference has to be negligible, and the focus should be on the legitimate requirements of the different categories of consumers and of protecting the environment. Regulatory agencies will be forced to be much more independent and professional too. Public's participation in all the major affairs of the sector will have to be much more.

Because of the widespread application of distributed type renewable energy sources, the focus will shift to making the distribution system much more efficient and reliable. Smart grids

will become very popular. Large size conventional power plants will become a rarity or may even be eliminated over a longer period. Since the focus will be to strengthen the distribution system, the need for additional HV/UHV transmission schemes can be expected to be much less.

A Case study on the state of Karnataka (Chapter 13).

A case study on Karnataka's power sector scenario indicates that the related issues are typical of most other states in the Union on many aspects. It is observed that the state of Karnataka can meet most of its electricity needs without having to rely too much on conventional power sources, as compared to the present situation. The case study has indicated that the chronic power cuts in the state can be entirely eliminated though efficiency improvements alone. This case study also provides a methodology to develop an integrated power policy framework for a state; and can be a model study for most of the other states too. What is needed is an objective consideration of each state's salient features on geography, climate, natural resource base, demography etc.. The objective consideration of strengths and constraints of each state can provide a clear indication of the development pathway for the state as well as the most suitable power demand/supply model. This case study may also provide a methodology to develop an integrated power policy framework for other states of the union, and for many developing countries.

Action Plan for a sustainable power policy (Chapter 14).

An objective review of the past policies w.r.t the true welfare of our communities will lead to a paradigm shift. Salient points of the recommended action plan for a sustainable, people friendly and environmentally friendly power policy in electricity production, transmission, distribution, utlisation and management are listed. An objective application of these recommendations will provide satisfactory solutions to the multiple crises facing the power sector.

Conclusions

In view of the gross inefficiency prevailing in the power sector, it can be said that the power cuts and all the other problems of the sector were/are entirely avoidable. Due to the impact on the society of conventional power projects and Global Warming implications, the society has no alternative but to become very responsible in managing the power sector and in conserving its natural resources. It is feasible to meet the legitimate electricity demand of all our communities satisfactorily with a national per capita electricity of about 1,000 kWH (per person per year at the national level), provided we ensure highest possible efficiencies in all aspects of

energy consumption. Such an approach is, anyway, essential for a sustainable life-style. The huge potential available in the form of renewable energy sources in tropical India, can provide most of this electricity. In order to move to such a regime a paradigm shift is required and a commitment to effectively involve various sections of the society in the relevant decision making process.

Through an objective review of the power sector in India and the past practices in it, the book has concluded: (i) the true demand for grid quality electricity is much less than the huge figure projected by IEP; (ii) the overall efficiency of the power sector is abysmally low; (iii) the need for additional conventional power plants need not be as huge as being planned/built; (iv) the natural resources and the general environment is being seriously impacted by a large number of ill-conceived conventional power projects; (v) an integrated and objective approach to the sector's multifarious problems can provide an integrated power demand/supply model where the highest possible efficiencies and widespread use of new & renewable electrical power sources can meet the legitimate demand for electricity of all sections of our society on a sustainable basis with minimum or negligible contribution from the conventional power sources; (vi) the power sector will continue to impact deleteriously the social, economic and environmental aspects of our society, unless a paradigm shift is adopted in the way our society looks at the demand/supply of electricity/energy.

Chapter 1

Introduction

– the need for an integrated power policy

Key terms: Integrated Energy Policy, integrated power policy, electricity demand, sustainability, Global Warming, efficiency, social and environmental issues; societal welfare, Finance Commission

Chapter Summary

Integrated Energy Policy, as developed by the Planning Commission in 2006, seems to have based its policy recommendations largely on technical, financial and logistical issues, ignoring the hugely important social and environmental aspects of our society. Hence urgent course corrections have become a necessity. Power sector being a predominant part of the energy policy needs an integrated approach in order to meet the needs of all sections of our society. Its impact on social, economic and environmental aspects of our society needs a holistic approach from the welfare perspective. What the society should be looking for is not electrical power itself, but the services such as lighting, heating, cooling, motive power etc. from the electrical power. Hence an integrated approach in determining which source of electricity is most suitable for which condition at minimum overall cost to the society can be determined only through Integrated Power Policy approach.

Integrated Energy Policy (IEP), as developed by the Planning Commission in 2006, is a crucial policy document, which is seen by many sections of our society and the establishment as guiding the medium to long term policy decisions of the government in the energy sector[1.1]. Power sector being a predominant part of the energy policy and in view of the long term implications of its recommendations, there is a need for the civil society to critically examine the recommendations and apply course corrections, where necessary.

It is an irony that while IEP has projected the inadequate quantity and quality of electrical power as a major impediment in the

economic development of the country and the human development index of our society, the power sector is also associated with many social and environmental problems because of poor policies/practice in it. Our society is witnessing popular agitations all over the country against power sector related issues such as forceful displacements; denial of access to natural resources such as forestry, fresh water and fishing; accelerated environmental degradation in the form of deforestation, unscientific mining, destruction/degradation of water bodies etc.; health problems from coal mining & coal power plants; threat of nuclear radiation etc. Increasing number of such agitations cannot be in the overall interest of the society as they lead to disharmony amongst communities and disenchantment within individual communities. Such a scenario demands diligent approach to study the causes & implications of such agitations, and urgent course corrections.

A modest understanding of the causes & implications of such agitations can point towards the shortcoming in power sector policies, due to which such agitations seem to have become inevitable. A modest understanding of the IEP indicates that there are many issues needing public debate because of the implications on sustainability and the long term impacts on social and environmental aspects. IEP refers largely to technical, financial and logistical issues but has ignored the hugely important social and environmental aspects of our society. Hence course corrections in this policy have become an basic necessity.

The clear need is to identify the shortcomings in the past practices, recommendations in IEP and the impact of these on the society and bio-diversity; to recognise that there is an urgent need for a paradigm shift in the electrical power sector front; and to focus on sustainable, people friendly and environmentally friendly power sector policies. In such a policy level discourse the emphasis should be on the order of magnitude than a high degree of accuracy while referring to the statistical information such as demand for power in future in MW of power or kWH of energy etc..

Major concerns to our society as far as recommendations of IEP are:

- Projection of huge additional power capacity based on continued high GDP growth rate;
- Advocacy towards heavy reliance on fossil fuels, especially the coal;
- Recommendation for large addition to hydel and nuclear power capacity;
- Low level of confidence on renewables, as against international thinking;

- Focus largely on energy sources with grid interaction capabilities;
- Inadequate attention to social and environmental aspects of large additional capacity.

Of the various forms of commercial energy available to our society, electricity has an overarching reach for many sections of our society, and it is also considered the most convenient form of energy. As per IEP about 78% of the domestic coal production is being used for electric power generation. The IEP projects that the composition of commercial primary energy sources in the country could be 50% of coal based electricity and about 29% of hydro electricity by 2031-32. Additionally, from the Global Warming perspective the electricity production is associated with about 53% of all CO_2 production and about 24% of GHG production in India. About 33% of the commercial energy used in Indian households is in the form of electricity as per National Sample Survey organization (NSSO 55th round). In view of this statistical strength the need for focusing on the electrical power sector need not be emphasized. IEP itself has dedicated much of its focus on power sector.

There have been reports that millions of people have been displaced since independence due to various development projects, including large power projects. A majority of such people are known to have become destitute in their own habitat because of insensitive rehabilitation processes. Such large scale displacements are not in the best interest of the society. Large additions to conventional power production capacity can exacerbate such problems.

The 13th finance commission (25.2.2010), had estimated that unless the public utilities engaged in transmission and distribution of electricity take urgent measures to improve the efficiency of operations the combined losses at the national level may increase from Rs. 68,643 crores in 2010-11 to Rs. 1,16,089 cores by 2014-15. Reports in January 2012 have indicated that such losses might have actually exceeded 120,000 Crores in 2010-11. The spurt in prices in the international coal market in late 2011, and decision by Coal India Ltd. to increase price have made such losses clearly inevitable, because the inefficiency in the power sector has continued to be huge. Such a huge loss is denying the adequate fund allocations to other essential sectors of our society such as poverty alleviation, drinking water needs, health, education, rural development, environmental protection etc.

The forest and tree cover in the country has reduced from about 40% at the time of independence to less than 25% in 2010 with huge implications on our general environment, bio-diversity, and natural support bases for the masses. Large number of additional

conventional power projects will only exacerbate these problems, and will make it impossible to meet the 33% target of forest & tree cover under National Forest Policy.

In view of the huge influence of power sector on social, cultural, heritage, health, economic, intergenerational and environmental aspects of our society, there is an urgent need for the society to take a holistic review of the entire power sector, and take the much needed course corrections. The issues like realistic demand projection, realistic tariff policies, objective identification of potential/constraints of various sources of power, huge emphasis on efficiency & accountability, true costs to the society, sustainability perspective, obligations to future generations, respect for societal views etc. can only be addressed effectively through a holistic approach. Hence a credible integrated power policy with people centric and environmental concerns has become critical for the all-round development of our communities.

Reference material

1.1: "Integrated Energy Policy":
(http://planningcommission.gov.in/reports/genrep/rep_intengy.pdf)

Chapter 2

Realistic Electricity Demand projection

– a crucial aspect of the future planning

Key terms: Realistic demand forecast, conventional power plants, renewable energy sources, GDP, CAGR, PLF, installed capacity, CEA, EPS, elasticity of consumption, renewable energy sources, per capita consumption, HDI, kWH, TWH, nature's limit, Global Warming

Chapter Summary

A credible electricity demand projection is critical for the responsible management of power sector. Whether the true projection of electricity production capacity is 1,700 BU @ 1,000 kWH per capita by Year 2070, OR 272,000 MW for 4% CAGR by 2031-32 is not as important, as the much needed holistic approach in managing the demand for a sustainable supply scenario. A realistic demand must to be estimated taking into account the social, economic, and environmental issues into objective account; changing consumption pattern across different sectors of our economy; nature's limit; Global Warming potential of energy consumption; and our obligations to the future generations. A carefully thought out strategy of responsible demand side management and sustainable energy supply options has become imminent for the long term welfare of our communities.

A crucial aspect of power sector management is the realistic forecast of power demand for the next hour, day, week, month and year, as also for next 10 to 25 years. Exaggerated demand projection seems to be the prime reason for a large number of conventional power plants being planned/ implemented in recent years. IEP has projected an increase in electricity generating capacity from about 153,000 MW in 2006 to 778,000 MW by 2031-32. A survey report by Prayas Energy Group released in 2011[2.1] has estimated that there are more than 700,000 MW of coal and gas plants waiting to be built in the coming years. This is in addition to about 60,000 MW of nuclear power and about 120,000 MW of hydel power by 2031-32 as projected by IEP. It is hard to believe

that the impact on our society and the environment of such a huge addition (totaling about 880,000 MW) in next 20-25 years will be negligible.

2.1 The issues with high demand projection

When considered in the backdrop of the fact that the total power production capacity of about 180,000 MW (as at the end of 2011) was achieved in about 64 years, the enormity of project related issues to the society of adding 880,000 MW in next 20-25 years may become clear. The social, economic, environmental, and health impacts on our densely populated communities of such a huge addition can be considerable, to say the least. Though there is no guarantee that all these proposed power plants may get built, even 50% of them can have huge consequences. It seems this large number of power plants is being proposed without due diligent studies about their true need, and without objectively considering the impacts on our densely populated communities.

Post Electricity Act 2003, power generation has become a de-licensed activity. In the XIIth Plan (Year 2012 – 17) more than 50% generation capacity addition is expected to come from private sector. Though, under normal circumstances no investor would put money solely based on Central Electricity Authority (CEA) forecasts of power demand, the situation in India seem to be different. Looking at the very large number of coal based power projects being proposed all over the country, it seems the private investors are rushing in to cash on the golden opportunity of profiting while there is a perceived need for lot of additional demand for electricity. Sadly, one cannot see much of diligent study w.r.t the real need for such a base load power during the economic life of the project; the optimum size and location of the project; the assurance of reliable supply of coal and water; the social & environmental impacts of such a project etc. Encouraging such a rush are the actions by the state governments, which are providing many incentives such as large chunks of lands at throwaway prices; assurance of large quantities of fresh water even at the risk of denying the same to the local population; tax holidays; financial guarantees; police protection to acquire lands against the will of the people etc. In many cases such incentives are disproportionate to the real benefits to the state, and hence are viewed as undue political favors to private firms/individuals. Almost all such project proposals are being vehemently opposed by the locals, who view the largesse by the state governments as a form of serious corruption.

In the absence of diligent study w.r.t the real need for such a large number of additional power projects, there are serious concerns that the huge costs incurred by the society, may not be commensurate with the benefits. In the worst case scenario we

would have stranded assets and an economic meltdown similar to the 2008 realty sector fiasco in the US. Already the banking sector exposure to power sector has become a cause of concern. The positive aspect of this development could be that if the private sector goes for efficient power generating units only, it should drive out the old & inefficient public sector units in the long run. However, the strain on our resources in the interim period would be difficult to tackle.

In order to avoid excess of production capacity, as is likely with the proposed number of plants in the country and which will result in massive burden on the society, a realistic demand projection is critical.

When the power demand projection is referred to, it is generally assumed to be on the integrated power network, and it is assumed that the isolated loads are not taken into account. The demand for electricity from isolated loads, such as captive power loads OR remote villages OR electricity supplied from distributed electricity sources such as DG sets, solar /wind / bio-mass units, or mini hydel units which may not be connected to the grid, are not considered in that context. The objective is to determine the minimum power production capacity to be connected to the grid in order to get satisfactory situation of power demand and supply.

A major issue with IEP is its high electricity demand growth projection by 2031-32. It assumes that in order to eradicate poverty the economy has to grow at 8 - 9%, and to support this much of growth and to meet the lifeline energy needs of the masses, the commercial energy supply would need to grow at about 6 % per annum upto 2031-32. In order to achieve this growth IEP has projected the installed electricity generating capacity to increase from 153,000 MW in 2006 to 778,000 MW by 2031-32 with substantial portion of the additional capacity based on coal. This projection of 5 times increase in electricity generating capacity seems to be based on the assumption of high demand growth by conventional demand projection methods. This figure works to about 6.4% compounded annual growth rate (CAGR) w.r.t the base figure of 153,000 MW in 2006. Such a growth rate in coal consumption will put tremendous pressure on the entire coal energy cycle, including the coal mining operations and the coal transportation infrastructure. It is difficult to imagine that the vulnerable sections of our society will not be adversely impacted by the infrastructural nightmares associated with the corresponding increase in mining, transportation and consumption activities. Forceful displacements; denial of access to natural resources; accelerated environmental degradation will all occur, and impact such sections.

The major concern with such a high electricity demand projection is that all the planning agencies of the Union government and state governments are likely to proceed with gusto to achieve that generation capacity target without the required due diligence process, as has already been noticed in the spurt in applications for additional power projects in recent years. The big question is: whether our society can afford such a huge additional demand on the grid, because all of such additional demand may not contribute to the economic development or may not lead to true welfare of our masses. But the social, economic and environmental impacts of such a huge addition to the installed capacity will be enormous, and may even defeat the very purpose of high GDP growth, which is the all round welfare of all sections of our society. In view of the fact that the fossil fuels, such as coal, natural gas and diesel, are fast running out and there is an inherent limit to the amount of energy we can draw from the nature, the inevitability of limiting the true electricity demand becomes clear. Hence there is a need to keep the overall power demand within manageable limits.

2.2 The problem with GDP growth centred demand forecast – leading to unsustainable practices

IEP, in its discussions on future energy demand, acknowledges the falling elasticity of electricity consumption/generation in the 13 years period between 1990-91 and 2003-04 as compared to the 23 years period between 1980-81 and 2003-04. This observed drop in elasticity from 1.3 to 1.06 has been projected to continue to drop to 0.78 for the 10 year period from 2021-22 and 2031-32. IEP also clearly acknowledges that energy elasticity of GDP can be shaped by policy interventions, the relative price of fuels, changes in technology, changes in end use efficiency of equipment, the level of energy infrastructure and development priorities that affects the structure of economy. In this context instead of recommending effective action plans to reduce the effective demand for electricity, IEP seem to have taken a path of high demand growth on the basis that the population will increase and the purchasing capacity of the general population associated with 8% GDP growth will increase. Such a projection seems unrealistic for the reasons discussed in the following paragraphs.

It may be useful to mention here as to how IEP has dealt with the electricity demand projection. It states: "… Having said this, it is emphasised that a rigorous demand analysis has not been conducted by the Committee and the numbers here and in Chapter III merely establish an indicative range of likely energy demand, supply and mix." It also says: " ..Similarly the elasticity for per capita electricity generation is only 1.06 since 1990-91 compared to

1.30 for the period since 1980-81. We have used electricity generation rather than consumption because while losses have been rising over time, precise data is not available on technical losses and commercial losses (which include pilferage, non-billing, and non-collection). Except for technical losses all electricity made available contributes to GDP. However, since even technical losses have been rising (current estimates are upwards of 15%) using electricity generation instead of actual consumption gives higher elasticity. Importantly though, the elasticity in India is falling over time (or with increasing GDP)."

It is true that demand projection for a commodity such as electricity for a point in time 25 -30 years ahead in a fast changing world is a very complex process, and a particular methodology used may not satisfy everyone. Also true is that it is difficult to project with a fair degree of accuracy. Hence it is practical to see such projection as an indicative range of likely electricity demand, supply and mix.

It appears that the electricity demand projection in IEP has been influenced considerably by the methodology used by Central Electricity Authority (CEA) in its periodic Electric Power Survey (EPS) reports. Hence it is relevant to throw light on how CEA goes about such demand projections.

CEA, in *Report on Seventeenth Electric Power Survey (EPS) of India* has projected CAGR of electricity consumption at the rate of 10% up to 2012 and 9% up to 2022[2.2]. The projected demand for peak load power is assumed to grow in same ratio. These two figures are very high and seem to have been arrived at through very conventional methods without factoring in the changes in the consumption factors. Dr. Bharat Jhunjhunwala, a development economist, has done a detailed study of the methodology used in CEA electricity projection[2.3].

Electricity prices are assumed by CEA to grow by two percent per year despite increasing role of private sector in electricity generation and distribution. While this assumption can be viewed as negation of the entire philosophy of liberalization and privatization, it would be appropriate to estimate lower demand for electricity due to higher price. This is ignored by CEA. This is especially important for demand during peak load hours of the day. In this way CEA seem to be variously making excessive projections of electricity requirement.

Dr. Jhunjhunwala has concluded that the basis on which very high projection of electricity demand has been made is on certain wrong assumptions wherein previous 30-year growth rates are used to make forecast for future consumption of electricity instead

of the latest 5 year growth rates. The 17th Power Survey gives the following data (table 1):

Table 1: Basic data from 17th EPS

Sl No	Time Period	Electricity Consumption CAGR (%)	Gross Generation CAGR (%)	GDP (93-94 prices) CAGR (%)	Elasticity Ratio Consumption / GDP	Elasticity Ratio Generation /GDP
1	30 Years: 2004-05 to 1974-75	6.87	7.47	5.40	1.27	1.38
2	5 Years: 2004-05 to 1999-00	4.30	4.37	5.90	0.73	0.74

It is clear from above table that there is a steep decline in CAGR of electricity consumption from 6.87% in last 30-years to 4.30% in last 5-years. CAGR of electricity generation too has declined from 7.47% in last 30-years to 4.37% in last 5-years. Yet, in making the forecast, CEA relies on the larger 30-Year CAGR statistics and ignores the recent 5-Year CAGR. The declining elasticity of electricity consumption in our economy is significant but is wholly ignored in CEA projections. The same argument seems to hold good for the demand projection by IEP.

Table 2: 5-Year growth rates (From 17th EPS)

	Period	GDP Growth Rate (Table 1.6)	Electricity Generated (Table 1.24B)
1	1996-97 to 2001-02 (Actual)	5.9%	5.8%
2	2001-02 to 2005-06 (Actual)	6.9%	4.8%
3	2005-06 to 2010-11 (Linear Projection)	8.0%	4.0%

CEA data indicates that GDP growth in India has exceeded that of electricity consumption in the 5 year period of 2004-05 to 1999-00 by a good 1.6%. This clearly indicates the continuous delinking of growth in our economy from the electricity consumption.

There is another dimension to the problem with the EPS reports. These reports generally have focused on peak demand (maximum demand for power during a day) on the interconnected power network and energy projection for the year without really giving an idea of how the load curve and the load duration curves would

vary over the years. The variation in electrical power consumption within a day is not the same throughout a given year, or over different years. For simplicity sake if the demand for power within a day is considered in 24 blocks of one hour each, the total electricity consumption in each of these blocks will generally not be the same. If the electricity consumption in each of these hourly blocks are computed over 365 days, and plotted on hourly basis for the entire year, the graph of such a spread will be different over different years. Hence peak demand for power and/or the total electrical energy required during one year alone will not give the true picture of the complexity associated with the power demand/supply scenario. To get the correct picture it is necessary to know how much power demand persists over what period in each day, and how the average of such graphs (called daily load curve) vary over different years. Without such an analysis EPS seem to have resorted to high demand projection, based only on the peak hour demand.

Considering the increasing domestic consumption and continuous growth in commercial sector/ urbanization, and increasing standard of living one would expect a lumpy load curve (where there can be higher load during a smaller period of the day, and lower demand in other parts of the day) in the near future unless appropriate course corrections are taken. This aspect is important when we look at the ideal generation mix to cater to the load curve. The recent/present trend of building a large number of coal based power plants should be reviewed carefully in this context, because they may not fit into such a power scenario, and may result in stranded assets or generation assets with low percentage of utilisation. Such a situation may lead to a huge but avoidable burden on the society.

The recent/present emphasis on coal based stations in the anxiety to bridge the gap between demand and supply of electricity (which is mostly during peak hours) is therefore a cause for alarm. On the other hand the efficiency in gas turbine stations is going up with the advent of aircraft type gas turbines used for power generation. Instead of building coal power plants to meet the peak demand shortages, gas turbines should be considered as peak load power plants, if adequate gas supply can be ensured.

The share of service sector in our GDP is increasing rapidly as against agriculture and the industry. This sector consisting of segments like IT, BT, Tourism, Telecom, healthcare, education etc. has taken off in a grand manner after the liberalization in 1990. It is well known that the services sector consumes electricity only in small quantities. In view of the unmistakable trend of increasing contribution of services sector to GDP but decreasing share in electricity consumption, we can say that the overall economy will

not need huge additional electricity for growth, as has been projected by IEP. On the other hand the change in consumption by domestic sector, as per CEA data, is large at 3.9% (between 2005-06 and 2011 -12). This means that we need electricity for consumption and raising the standards of living by the people. While this may be acceptable, this fact also gives an entirely different dimension to the increased generation of electricity. Generation of electricity for economic growth may be expected to provide trickle-down or secondary benefits while that for consumption does not. CEA fails to recognize this and passes off the increased need for electricity as necessary for economic growth while it is largely for consumption.

Dr. Jhunjhunwala concludes: "The unmistakable conclusion is that CEA has deliberately ignored its own latest 5-Year data and relied on the previous 30-Year data to make excessive forecasts of electricity consumption. These forecasts have then become the basis of India bending to make an agreement with the U.S. for nuclear power and the country destroying its rivers and land mass for generation of hydropower."

Installed power capacity in the country has grown at 5.87% per annum over 25 years period previous to 2003 as per IEP. Despite such massive increase in installed power capacity during the previous 25 years, about 57% of the rural households and about 44% of the total households in the country did not have electricity in 2000 as per IEP. Many reports indicate that even in 2009 more than 40% of the total households in the country did not have electricity. IEP recognizes that the energy intensity of our economy has been falling, and is half of what it used to be in the early 70s but there is significant room to improve.

IEP's projected installed power capacity of 778,000 MW by 2031-32 appears to be unrealistic due to various factors: international efforts are accelerating to contain the Global Warming through measures such as energy efficiency improvement, energy conservation, demand side management (DSM); there are increased use of distributed type renewable energy sources which will reduce the demand on the integrated grid; international co-operative efforts are gaining momentum to reduce the use of fossil fuels; India has launched 8 national missions, including one on energy efficiency, to combat Global Warming; the overall efficiency of the power sector is poor indicting the huge scope for improvements. All these measures, if undertaken earnestly, will reduce the effective grid demand for electricity by a considerable margin. Additionally, since this projection is on the assumption that the electricity demand will grow at 6.4% CAGR, even the decreasing elasticity of demand due to strong growth in services sector is wholly ignored. Hence it is realistic to say that IEP

projection of 778,000 MW installed power capacity by 2031-32 is exaggerated, and hence should be a concern because on the basis of such projection massive power capacity addition can happen at huge but avoidable costs to the society.

Whereas the assumption that a high GDP growth rate of 8-9 % through 2031-32 will alleviate poverty in the country early due to trickle down effect is itself seriously questioned, it should be noted that the huge growth in the installed power capacity during 64 years of independence has not been able to provide even the life line electricity to more than 40% of the households. Various official reports, (including the ones from Central Electricity Authority, Central Statistical Organisation, replies to Parliament questions etc.) have indicated a massive increase in electricity generating capacity since independence. Installed electricity generating capacity in the country has grown phenomenally from about 1,400 MW in 1948 to about 180,000 MW in June 2011; an increase of 128 times. Annual electricity generation from all sources has increased from about 61,000 MU in 1970-71 to 724,000 MU in 2008-09 an increase of 12 times in 30 years. The national per capita consumption has gone up from 238 kWH in 1989-90 to about 780 kWH in 2011, an increase of more than 3.2 times in 21 years. Despite such phenomenal increases in generation capacity since independence, considerable sections of our population are

> The total installed generating capacity in the country has gone up from 58,012 MW in 1989 to 1,52,148 MW in 2009, a whopping 162% increase. Total monthly generation from conventional sources has increased from 43,596 MU in March 2000 to 65,057 MU in March 2008, an increase of about 50%. National per capita electricity consumption has gone up from 283 kWH in 1992-93 to 429 in 2005-06, an increase of 52%. But 44% of the households, mostly in rural areas, have no access to electricity even in 2009.
>
> *(Source: as per Central Statistical Organisation (CSO) & Press Information Bureau, Govt. of India)*

still deprived of electricity connection, and various forms of electricity crises are continuing. So, massive addition to generating capacity alone cannot be seen as the panacea for our electricity problems.

2.3 The past & present practice of exaggerated demand projections

Dr. Jhunjhunwala quotes Patrick McCully in "Silenced Rivers" that the over projection of electricity demand is a regular pattern

adopted by most bureaucracies: "Electricity demand forecasts consistently overestimate future needs for electricity. In more than 100 national demand forecasts used by the World Bank, actual demand seven years after the forecasts were made was on the average one-fifth lower than that had been projected. The deviation between projected and actual (demand) increased with the number of years from the date of forecast." The demand projection and the actual during the last few years in the country, as in table 3, seem to corroborate what Patrick McCully has said.

Table 3: Demand Forecast and Actuals (From agenda for 18th EPS)

	Energy Requirements (MU)			Peak Load (MW)		
Year	17th EPS	Actual	Deviation(%)	17th EPS	Actual	Deviation(%)
2004-05	6,02,787	5,91,373	1.89	90,221	87,906	2.57
2005-06	6,54,603	6,31,554	3.52	97,269	93,255	4.13
2006-07	6,97,961	6,90,587	1.06	1,04,867	1,00,715	3.96
2007-08	7,44,515	7,39,343	0.69	1,13,059	1,08,866	3.71
2008-09	7,94,561	7,77,039	2.21	1,21,891	1,09,809	9.91
2009-10	8,48,390	8,30,594	2.1	1,31,413	1,19,166	9.32

The peak requirement is the main driver for higher capacity addition. GDP growth rates for India are dependent on the world economy too. A sustained high growth rate year after year may not be sustainable. The official projection of economic growth for year 2012-13 has been reduced to less than 7% as of January 2012. Human Development Index (HDI) improvement might be considered as the objective function rather than GDP growth.

It is a common fact that working out energy and peak requirement of the country in a shortage scenario can become highly subjective. There seems to be a tendency on the part of states of our Union to project shortages on the higher side so as to get a larger share of Central assistance (as seems to be the case all over the developing world). Hence by itself, the actual requirement figures in the above table are optimistic. Despite this optimistic assessment it is seen that the peak forecast as per the 17th EPS is higher by 9% for the last two years (2008 to 2010). Even if people attribute it to recessionary conditions in the economy, there is no corresponding reduction in the energy requirement which should have occurred on account of recession.

In view of the fact that that there is a steep decline in CAGR of electricity consumption from 6.87% in the 30-year period (between 1974-5 and 2004-05) to 4.30% in last 5-years (between 1999-2000 and 2004-05), and taking into account all the above mentioned factors, it can be argued that not more than 4% of CAGR of electricity consumption for next 20-25 years seems reasonable.

More importantly, it appears feasible to restrict the actual electricity demand growth to this level without compromising the welfare of our communities. On the basis of all these arguments the scenario emerges that the total installed capacity in the country by 2031-32 need not be much more than the range of 388,000 MW (for 4% CAGR) to 497,000 MW (5% CAGR). This is in stark contrast to the range of 778,000 MW (at 8% CAGR) to 960,000 MW (at 9% CAGR) as projected by IEP.

2.4 Need for reducing the effective grid electricity demand – Global warming considerations

In the context of the STATE strongly advocating the high GDP growth centered development, the society has to address a much more fundamental question as to whether we should aim at such a GDP growth rate for the next 20 years, as IEP seems to indicate for the period upto 2031-32. Such a high GDP growth rate, year after year, will mean the manufacture of products and provision of services at an unprecedented pace leading to: setting up of large number of additional factories/manufacturing facilities; consumption of large quantities of raw materials; unsustainably increasing demand for natural resources such as water, minerals, timber etc.; acute pressure on the govt. to divert agricultural/forest lands for other purposes; huge demand for energy; clamor for more of airports, air lines, hotels, shopping malls, private vehicles, express highways etc. Vast increase in each of these activities, while increasing the total GHG emissions, will also reduce the ability of natural carbon sinks such as forests to absorb GHG emissions. These consequences will also result in depriving the weaker sections of the society even the basic access to natural resources, while driving the fragile environment to a point of no return.

Does our society need such an eventuality? Is this what we want from Global Warming perspective? Can we see the overall welfare of the vulnerable sections of our society in this scenario? Hence the present practice of electricity demand projection based on a high GDP growth rate needs to be viewed with much more objectivity. The primary objective should be to remove poverty of the masses.

Whereas Indian government's stand in international Climate Change negotiations has been that it should have no obligation of targeted reduction of GHG emissions (because its per capita GHG emissions is much below the world average), the energy profligacy and inequitable energy consumption pattern within India should be of a major concern. Much of the population, which is in lower income group, have per capita CO_2 emissions of about 335 kg, while a section of the population with the highest income group have per capita CO_2

emissions of about 1,500 kg. This was the summary of a survey report by Greenpeace India under the title “Hiding Behind the Poor”[2.4], wherein it was shown that in India the richest consumer classes produce 4.5 times more CO_2 (because of higher energy consumption) than the poorest class, and almost 3 times more than the average Indian (501 kg). Because of close linkage of CO_2 emission to energy usage, the societal impact of such inequitable energy consumption pattern is that the poorest will be the most affected by the Global Warming, while the energy profligacy of the rich is the main cause for Global Warming. By removing such huge inequities through reduction in the energy profligacy of the rich, the legitimate overall demand for electricity can be reduced while meeting the life-line electricity needs of the poor.

A December 2009 study report by title “Still Waiting”[2.5] by Greenpeace India indicates that while most of the additional installed capacity during the last 10 years has gone on to meet the escalating demand for electricity in urban areas; the rural communities continue to be denied with even the life line electricity. This report also highlights that whereas the state capitals are getting between 23- 24 hours of electricity supply on an average, larger towns and cities are getting between 21- 23 hours of supply, villages are not getting even 12 hours of assured supply. It should be a matter of grave concern to a welfare society such as ours that whereas the energy profligacy in Urban areas is

Dr, Bharat Jhunjhunwala makes an interesting observation in his petition against Union of India in the Supreme Court in the matter of how CEA is erring in techno-economic clearances for hydel projects. He has said:
The number of rural households to be electrified in April 2005 was 40,853,584 while those electrified in the period April 2005 to January 2009 was 5,679,143. Every month 123,459 new households were provided with electricity in this period. The increase in electricity required every month for supply to these 123,459 households is 7.3 million units per month at the life-line consumption of 30 Units per month. The generation of electricity in the country in 2005-06 was 58.1 billion units per month. Generation increased to 65 billion units per month in August 2009. The increase in generation was 6.9 billion units in 41 months or 168 million units per month. Of this, only 7.3 million units or only 4.3 percent was used for rural electrification. The total requirement of electricity for the 40,853,584 un-electrified households is 1.2 billion units per month. This is only 1.8 percent of the average generation/month already achieved in 2010-11.
The clinching point in this regard is: if our society cannot dedicate 1.8% of the total electricity produced in the country to the 40% of the rural households even for life line electricity, how can we say that all the additional electricity being generated every year is for the sake of providing electricity to the un-electrified households? The reality is that almost all of the additional electricity produced in the country every year is going to cater to the increased demand by those who already have access to electricity, while many sections of the population continues to be without access even to life-line electricity. The huge social inequity year after year prevailing in the country due to gross indifference of the STATE is glaring.

escalating unabated in the form of air conditioners, AC shopping malls, electronic gadgets, night time sports, vulgar use of lighting for commercial advertisements, unscientific use of electricity for streetlights etc. the villages are not getting even life line energy.

Whereas the STATE continues to say that large addition to installed electricity generating capacity is essential to provide electricity to 100% rural households, a blatant discrimination exists where cities are registering continuous increase in per capita consumption of electricity, and the rural areas are being denied of electricity even for the basic applications such as lighting and drinking water. The problem of Urban-Rural discrimination in electricity supply can be exemplified by author's own experience in rural India (Annexure 1).

2.5 The scope for reducing the effective grid electricity demand – efficiency improvement opportunities

If the energy profligacy in Urban India and by the rich is contained to the manageable level, the saved energy is likely to be so huge that 100 percent household electrification in villages may be achieved and life line energy for every house hold can be assured even with the existing generating capacity. Keeping in view the huge potential in distributed electricity sources such as roof top solar systems and community based bio-mass plants etc. and the efficiency improvement measures it is not inconceivable that through the existing techno-economically viable means it is feasible to drastically reduce the effective demand on the grid based electricity network. A study of the Karnataka power system in 2008 by the author has indicated that the existing demand for electricity in the state can be effectively reduced by as much as 50% by these measures [2.6].

The average Plant Load Factor (PLF) of thermal power stations in the country is reported to be about 75%, while the best run power plants of National Thermal Power Corporation (NTPC) have PLF of above 90%. Some of the coal power plants in the eastern and north-eastern states are reported to be operating at less than 40% PLF. With about 93,000 MW of total installed thermal power capacity in the country, the increase in average PLF to 90% will save the need for about 11,000 MW of additional installed power capacity.

It is techno-economically feasible to reduce the technical losses in transmission and distribution of electricity from the present level of about 25% to less than 10%, as has been demonstrated in certain pockets such as Bangalore city. This step alone can reduce the need for additional installed power capacity of about 15,000 – 20,000 MW at the national level.

The inefficiency in end use applications also is unacceptably high. As per a recent study report by Prayas Energy Group, Pune [2.7] usage of energy efficient models of common house hold appliances such as lamps, refrigerators, fans, TVs, radios etc. can result in about 30% energy savings in households annually by 2013. This may correspond to an avoided additional generating capacity of about 25,000 MW.

> A press release on 31st March 2011 by Press Information Bureau, Ministry of Power refers to a study on potential savings in the states, and indicates that the total consumption assessed in all States is 501,003 MU of electricity; there is a deficit of 73,093 MU and the total energy saving potential is 75,364.08 MU. This is about 15 % of the total consumption. This clearly indicates that in reality there is no need for the crippling power cuts we are experiencing year after year.

At the national level about 30% of all the electrical energy consumed is attributed to the agricultural sector in the form of irrigation pump (IP) sets. In Karnataka this figure was about 38% in 2006. It is also an established fact that for various technical reasons the majority of these pump sets is so uneconomical/ inefficient that they are consuming about 40 to 50% more energy than really needed to perform the designated task [2.8]. A quick estimate indicates that the loss reduction techniques (at an average cost of about Rs. 5,000 -10,000 per set) can reduce the existing loss level from about 40% to about 10% providing huge savings each year. Such a measure is estimated to yield an additional virtual generation capacity of about 1,500 MW in Karnataka alone. Improving the overall efficiency of these pump-sets from the suction end to the delivery end at the national level will save a huge quantity of electrical energy of about 12 – 15% annually. Any amount of effective investment in this sector will be worthy of the cause, because not only the perpetual energy losses will be avoided, but will also result in all-round economic benefits like higher agricultural production and industrial production.

The potential to reduce the effective demand on the power system through IP sets is so huge that the Andhra Pradesh government was reported to have taken a decision few years ago to replace all old and inefficient agricultural pump sets by high efficiency sets at a budgeted cost of Rs. 15,000 crores. Since about 30% of the total energy consumed is in the agricultural sector, it also indicates the huge demand for electricity in the agricultural sector, which when reduced to international best practice levels can reduce the effective demand on the power system grid by a considerable margin. IEP has failed to identify such a vast virtual source of additional power. In other words the effective demand for electricity at present can be reduced by about 10-

15% by improving the electricity consumption efficiency in agricultural sector alone.

In the current scenario, the huge potential to reduce the electricity demand for agricultural pumping through effective rainwater harvesting has also escaped the attention of IEP. With the ground water table getting continuously lower and lower, the energy required to pump water will continue to increase unless remedial measures are taken on a war footing. With effective and widespread rain water harvesting measures the electricity demand for water pumping for agricultural and domestic needs can be reduced considerably. The fact that agricultural pumping is accounting for about 30% of the total electricity consumed and that water is being lifted from depths more than 500 feet in certain parts of the country must force our society to consider the rain water harvesting to reduce agricultural pumping loads very seriously. Rain water harvesting can contribute to few other welfare measures also such as; increased agricultural production, increased quality of drinking water, and water security.

The huge potential to reduce the effective demand on the electricity grid network in India through efficiency improvement in appliances can be exemplified by one example of USA quoted in IEP document. The specific consumption of electricity in refrigerators in USA came down from a level of 1,800 kWH per year in 1974 to a level of 476 kWH per year in 2001 (i.e 75% reduction) consequent to a series of measures including enforcement of efficiency standards. Bureau of Energy Efficiency under the Ministry of Power (MoP) estimates that the replacement of incandescent lamps by Compact Fluorescent Lamps (CFL) alone can save in excess of 10,000 MW of additional power capacity.

In view of the growing pressure to reduce the GHG emissions to contain Global Warming, the central govt. has assured the international community that it will reduce the energy intensity of its economy by 20% by the year 2020. It is credible to expect a host of effective measures in this regard, which will reduce the energy demand in many areas of our economy in the years to come.

IEP itself has admitted that the potential of DSM to reduce the effective demand is about 25%.

The argument that the total installed capacity in the country by 2031-32 need not be more than 388,000 MW (for 4% CAGR) to 497,000 MW (5% CAGR) can be further reviewed in this context. Taking all the efficiency improvement measures into objective account, it may not be out of reality that the effective demand can come down by about 30%. Hence it can be further argued that the

effective grid demand by 2031-32 need only be about 70% of 388,000 MW, which is about 272,000 MW. Since the present installed capacity is already about 180,000 MW, there seems to be a need for only about 92,000 MW additionally between now and 2031-32. With adequate emphasis on transferring most of the smaller loads such as lighting in domestic, commercial and streetlights etc. and appliances such as TV, computers, small water pumps etc. on to distributed renewable energy sources such as roof top solar PV panels, roof top solar/wind hybrids, community based bio-mass systems etc. the demand on the grid can be further reduced. But such a scenario demands concerted efforts at all levels of our society.

With the increasing focus on wide spread use of distributed renewable energy sources, the real growth of the integrated grid demand can largely be contained within manageable limits in future. If we objectively consider the true potential of distributed renewable energy sources it is reasonable to project that all the capacity addition from now onwards can come from renewable energy only. Since India has huge potential in renewable energy sources, this argument should be seriously considered for implementation, as is being done to some extent through the Ministry of New & Renewable Energy (MNRE). It can also be deduced that the large number of conventional power plants in the pipeline must be reviewed in this context, and drastic action must be taken to minimize them.

The divergence of views on demand forecast, and hence the divergence of the approach to the same as per conventional methods can be noticed in the table below. It should be noted that IEP itself has ignored the Ministry of Power projection of 962,000 MW of installed capacity by 2031-32 on the premise that it is high.

Table 4: Projection of Installed Electricity Generating Capacity by 2031-32

Projection by	Unit	@ 4% CAGR	@ 5% CAGR	@ 8% GDP	@ 9% GDP	Comments
Ministry of Power	MW	-	-	962,000	1207,000	From a base of 140,000 MW in 2006
IEP	MW	-	-	778,000	960,000	From a base of 153,000 MW in 2006
Author's argument	MW	272,000	341,00	-	-	From a base of 140,000 MW in 2006

Going by our past record of actual annual growth in consumption, and the possibility that energy intensity of our economy will keep going down for decades, the projection of demand growth at CAGR

of 4-5% may seem reasonable. However, honest efforts must be made continuously to limit our peak electricity demand so as not to exceed 85-90 % of the total installed capacity.

> In view of the huge deleterious impacts on our society of conventional technology energy sources such as coal based, dam based or nuclear based power projects all out efforts must be made to minimise the number of such power plants by containing the legitimate demand for electricity to a manageable level through all credible measures. Nature's limit in providing energy from such sources and its ability to absorb the impacts of various activities associated with such sources should be of critical consideration.

For inexplicable reasons IEP has not taken such a holistic approach to curtail effective electricity demand on the grid. Unfortunately, IEP has implicitly or explicitly adapted the GNP maximizing paradigm to estimate energy/electricity demand which may lead to potentially serious consequences to our communities. In view of the many serious implications of unlimited energy demand as discussed in this section, there is rather an inevitable requirement to estimate objectively what is the least amount of energy needed to wipe out poverty, and how best to meet it in a sustainable manner.

There is no escaping the inevitability of the need to decouple our economic growth from increase in energy consumption.

2.6 What constitutes true electricity demand in India? – profligacy in urban areas V/S denial for rural areas

Many attempts have been made to project future electricity demand in the country. One such recent effort in the article[2.9] by Dr. S. P. Sukhatme of IITB was based on per capita electricity consumption. This article assumes that a per capita consumption of 2,000 kWH/annum would be needed to ensure adequate level of Human Development Index (HDI) in the country by 2070, and that the projected total electricity production requirement in the country should be 3,400 Billion Units (or TWH) per year by 2070. The article also asserts that only about 36% of such electricity may come from renewables, and the rest may have to come from fossil fuels and nuclear. Keeping in mind the unanimity across the globe that the usage of fossil fuels must be drastically reduced to check the Global Warming, it needs to be questioned as to how the country can afford to get about 64% of its electricity from fossil fuels and nuclear even as late as by Year 2070.

Since improving the HDI of the poor people in the country is quoted as the objective of large number of additional power projects being planned all over the country, increasing the electricity availability to the domestic consumers in rural area (who are the most affected by poor performance of the power

sector) must be of highest priority. This objective can be easily achieved by ensuring equitable distribution of the electricity already being produced in the country among different sections of the society. But far from making attempts in this direction the electricity made available to urban and rich households is increasing vastly since decades, while millions in our villagers remain without access electricity, and even those villages which have access to electricity have deplorable quality of electricity supply. So the argument that additional power projects are required to provide electricity to the un-electrified houses is at best called a fallacy. There is so much of wastage and luxurious usage of electricity in urban areas, that even if a small portion of such saved electricity is made available to un-electrified houses, every house in the country can get a minimum life line electricity of 30 Units per month, which is also the target set by the Planning Commission in IEP.

Table 5: India's Installed Power Capacity & Net Availability

(Source: Deduced from the data on CEA website as on 30.4.2012)

Fuel	MW {A}	Aux. consumption @ 10 % for thermal & nuclear; @2 % for hydro & renewables {B}	Unplanned Outage @ 5% {C}	Planned outage @5% {D}	Net capacity Available for use {A-B-C-D}
Total Thermal	133,363	13,336	6,681	6,681	106,665
Coal	113,782	-	-	-	-
Gas	18,381	-	-	-	-
Oil	1,200	-	-	-	-
Hydro	38,990	780	1,950	1,950	34,310
Nuclear	4,780	478	239	239	3,824
Renewable	24.503	369	7,382	738	16,014
Total	**201,637**	**14,963**	**16,252**	**9,608**	**160,814**

(Note: 40% unplanned outage assumed for renewables because of the low plant load factors)

The above table provides a high level indication of the inefficiency with which our power sector is being managed. Whereas the total installed power generating capacity in the country was 201,637 MW as on 30 April 2012, the peak demand on the system for year 2011-12 was 130,250 MW (as per CEA website). As can be seen from the above table the total power capacity which should have been available for utilisation (after allowing for station auxiliary

consumption, planned and unplanned outages) was about 160,800 MW. Even if we assume that 40% of the renewable energy source capacity was not available during peak hours due to unplanned outage (which are generally complained as having low plant load factor), the effective available capacity should have been about 160,800 MW. Hence the power system should have seen a surplus of about 30,000 MW, but instead it recorded a peak deficit of 14,403 MW (11.1%) during 2011-12. Even if we completely ignore the contribution of renewable energy source capacity, the system should have been surplus by about 14,000 MW. This high level analysis clearly shows that there is really no need for power cuts, and that the real need for additional generating capacity may be much less than that is being projected by the planning agencies.

A practical example can illustrate better the fact that the present national average of 780 kWH per capita is not small in the Indian context. The author is living in a village of about 200 houses, and the monthly electricity consumption of his family of three at present from the grid is about 60 Units, which he finds to be of adequate level as demonstrated by the comfortable life style he has (with a water pump, TV, computer, CFLs for lighting, an exhaust fan, phones needing electric charging, and a CD player). This works out to about 240 kWH per capita /annum. Most of the rural houses in India will not have so many gadgets demanding electricity, at least in the near future. Hence an average per capita of about 150 kWH /annum can be seen as adequate for rural population, who basically are looking for electricity for lighting, TV, fans, and one or two power plug points for charging appliances like Cell Phone. Also a typical family size in villages is generally higher than that in urban areas. On an average it may be between 5 and 6 per family. As of now it is difficult to imagine how a rural household will need more than this level of electricity consumption for a decent life style and to improve its HDI. Most of the rural families also may not be economically strong/ willing to pay for higher electricity consumption. Even if we assume that some of the rural houses may have to use electric stoves for cooking and electric geysers for bathing purposes a per capita electricity usage from the grid of 240 kWH /annum should be more than adequate for an acceptable level of HDI. The society can and must make concerted efforts to minimize grid electricity consumption in applications where LPG or bio-mass or solar energy is feasible, at least in rural areas.

As compared to this low electricity consumption in villages, the average monthly electricity consumption of a family of 4 people in cities like Bangalore and Mysore is known to be in the range of 160 to 200 Units. If we look at the common appliances used in such urban houses (i.e adequate lighting, water pumping, fans, mixer/grinder, TV, radio, computer, electric geysers, electric stoves, refrigerator, washing machines, VCPs etc.) one can say that these houses already have a high level of comfort and an acceptable level of HDI. The only issue in urban areas seems to be that the

reliability of electricity supply is bad. Assuming on an average 4 people in a family this monthly consumption of 200 units works out to 600 kWH/annum of per capita for an average urban family. Allowing a higher per capita consumption needs in hotter urban places like Delhi/Jaipur during summer, and lower consumption in cooler places like Mysore/Ooty etc, it may not be out of place to assume that on an average a per capita of 600 kWH per year should be adequate for domestic purposes in urban areas. Let us remember that this is for only about 35% of the population which is living at present in urban areas. The projections are that by 2050 about 40 to 45% of our population may live in urban areas. Assuming that it will be about 50% by 2070 we should assess the minimum electricity requirement at the national level. On this basis of 50% population in urban areas and 50% in rural areas it may be safe to assume that a per capita consumption of 420 kWH (= 0.5*600+0.5*240) at the national level for domestic usage can be expected to provide an acceptable level of HDI.

Having identified the electricity needs of domestic consumers, let us consider the electricity needs of economic entities such as industries, agriculture, commercial establishments; common services like water pumping, street lighting, water pumping, sewerage treatment, railway traction, govt. offices, schools, colleges, public places, entertainment etc. as long we keep the wastages under check. Of the present national average of 780 kWH/annum of per capita (during the year 2010 -11 as per CEA) the remaining 360 kWH per capita after accounting for domestic uses (780 - 420 kWH) should be able to meet a satisfactory level of common services requirement as being experienced now. We should bear in mind that even with a low per capita national figure of 780 kWH (as compared to the world average), India is already recognized as a major economy indicating that its impact through industrial and commercial development is not insignificant.

2.7 How much electricity is needed for non-domestic usage in India?

Since the primary objective of producing more electricity is stated to be the overall welfare of our communities, and since a per capita consumption of 420 kWH is argued to be adequate, the focus should be on the amount of electricity which may be needed for all other non-domestic applications.

Even if we assume that these common service requirements (other than domestic consumption of electricity) have to increase by a considerable margin to provide acceptable level of economic growth and life style by 2070, the total electricity consumption at the national level per capita of about 1,000 kWH/annum may be adequate, keeping in view that our population is growing, and the electricity that can made available for such common service requirements will also increase substantially between now and 2070 when the population is expected to increase from 1.2 Billion

now to 1.7 Billion. The huge inefficiency prevailing in all segments of the power sector clearly indicates that much higher amount of electricity can be made available for such common services even at the present per capita of 780 kWH. As clearly recognized in IEP there is a scope for reducing the electricity demand by about 25%. High level estimation indicates that taking the efficiency of various segments of our power sector to levels of international best practice, the overall savings can be of the order of about 40%. This basically means that the present per capita of production of 780 kWH can become as effective as about 1,100 kWH.

This deduction may be illustrated better in a tabular form (table 6). With the assumption that a per capita consumption of 420 kWH for domestic purpose is considered adequate, the amount of electricity that can be made available for non-domestic purposes by the year 2070 is compared between per capita production of 780 kWH (as at present) and 1,000 kWH. The huge scope available in reducing the T&D losses to about 5% is kept in mind, and hence this 5% loss is included in the electricity made available for non-domestic purposes by 2070. It is clear from this table that by 2070 the electricity that can be made available for non-domestic purposes can be increased by 99% at 780 kWH per capita production, and by 300% at 1,000 kWH per capita production. It should also to be noted that by 2070 the electricity that can be made available for non-domestic purposes (986 Billion Units) will be 20% more than the total electricity production in 2011(811 Billion Units). Hence, the electricity that can be made available for non-domestic purposes in 2070 can be considered adequate if care is taken to minimize the losses and wasteful consumption.

Table 6: Comparison of electricity for non-domestic purposes

	@ 780 kWH per capita production	**@ 1000 kWH per capita production**
Actual electricity production in 2010-11 (population of 1.2 billion)	811 Billion Units	Not applicable
Electricity available for non-domestic usage in 2010-11 (assuming per capita consumption of 420 kWH for domestic purpose)	307 Billion Units	Not applicable
Total electricity production in 2070 (population of 1.7 billion)	1326 Billion Units	1700 Billion Units
Total electricity available for non-domestic usage in 2070 (assuming per capita consumption of 420 kWH for domestic purpose)	612 Billion Units	986 Billion Units
Increase in total electricity available for non-domestic usage by 2070 over 2010-11	99%	302%

(Years 2010 and 2070)

Considering the fact that we already have a considerable industrial and commercial base, and considering the fact that there is gross inefficiency and wastage in the end use applications it may not be unreasonable to project that 1,000 kWH of per capita consumption for 1.7 Billion population projected in 2070 will lead to adequate HDI. This increase from the average of 780 kWH per capita for a population base of 1.2 Billion at present to 1,000 kWH in 2070 for the population base of 1.7 Billion should be able to take care of all the additional energy required for the non-domestic uses of the nation. Anyway, the rural population will not need as much energy consumption as the urban population even for common service requirements.

If the focus in future (say by 2030 or 2050) is towards distributed type of renewable energy sources, as it should be, higher per capita electricity need not be such a major concern, because the net demand on the integrated grid can be controlled effectively.

The comparison of per capita consumption in our society with that of developed countries should not be an option at all, because it is already being felt that the energy consumption in the developed countries is not sustainable, as can be seen in the Global Warming debate. Hence even though 1,000 kWH/annum as average per capita consumption will appear much less as compared to that in developed nations, all out efforts should be made to reduce it even further keeping in view the nature's limit to support high energy demand, and the impact on our society and the environment of setting up a large number of conventional power plants. The main focus must be to minimize the electricity consumption through high levels of efficiency, and by minimizing the wastages and luxury usages.

Keeping in view the potential to save about 35-40% of the prevailing demand, the present per capita of electricity production of 780 kWH per annum can be seen in effect equivalent to about 1,100 kWH per capita. In an objective sense it may mean that there is in reality no need for the large number of additional capacity being planned and implemented in the country. The present electricity infrastructure must be operated at the highest possible efficiencies, with utmost responsibility, and the so produced electricity should be distributed equitably to all sections of our society. Adequate encouragement should be provided for the widespread usage of distributed renewable energy sources so that the decommissioning of every old and inefficient conventional power plant can be matched by equivalent production capacity of renewable energy sources.

2.8 Electricity/energy demand and development paradigm for India

In order to keep the power demand to a manageable level and also

to ensure an inclusive growth our development paradigm has to be vastly different than what we have been witnessing during the last 64 years. There is the need to adapt Indian civilizational values as exemplified by our ancestors: simple living. There can be no escape from the harsh reality behind this vision espoused for the country by Mahatma Gandhi, as far as harnessing our nature is concerned.

In view of the looming crises associated with Global Warming IEA has been publishing its flagship World Energy Outlook regularly giving a clarion call for energy revolution. A developing country like India with more than a billion population and fast expanding economy can and must play a critical role by showing a new paradigm of development, not only for the developing countries, but also for the developed countries which are responsible for much of the GHG emissions. It should be a development based on India's much celebrated civilizational message of "simple living and high thinking".

It is high time we also questioned the very fundamental concept of the need for ever increasing gross domestic product (GDP) to achieve the fantasy of development. This development concept requiring mindless consumption of unsustainable natural resources is the root cause for the current energy crisis, and hence must be thoroughly reviewed.

Unfortunately despite all the advantages – namely still rural based economy, not yet addicted to much of commercial energy, potential to transit to knowledge economy from agricultural economy skipping industrial economy, and inheriting the values from more than 5,000 years old civilization - Indian political system is influenced more by the western belief of material wealth. As is in India, many developing countries are confronted with a crippling multi-dimensional energy crisis. Energy security has become a major factor stifling the economic growth, frequently igniting political crisis, governance problems and civil unrest.

The Civil Society through our government should on a war footing take steps to put Indian development on a totally different path of sustainable living which minimize the use of energy. The goal of development should not be ever increasing GNP, but minimizing the number of people living below the poverty line in the shortest possible time. Not only India should reduce/stop the process of urbanization, it should seriously consider adapting policies of reversing the urbanization. Most Indian cities have reached the critical stage, and life for most in such cities is unbearable because of traffic congestion, lack of drinking water, frequent brown outs and black outs, ever present garbage, pollution of various kinds, health problems etc. The huge additional investments, which are going in to make these urban concrete jungles somewhat tolerable,

if invested wisely in rural infrastructure development can enable the country to achieve its HDI target much early than is considered possible by the ongoing paradigm.

Electricity supply in rural areas is a classical case of 'L-I-F-O' (last-in-first-out); the last to get supply and first to get disconnected in a shortage situation. So, the argument of needing additional power production capacity to provide electricity connection to rural India is simply not tenable.

Sustainable living should not remain as a simple slogan to quote the famous words of Mahatma Gandhi. It should be the main deciding factor influencing India's developmental and energy policies. Human Development Index should be redesigned to take into account the percentage of people living blow the poverty line, educational achievement, longevity, and inversely proportional to per capita energy consumption. In other words the world should move away from this mindless race of ever increasing gross domestic product.

UN Conference of 1974 had adopted "The Cocoyoc Declaration" which had said on the purpose of development: "Our first concern is to redefine the whole purpose of development. This should not be to develop things but to develop man. Human beings have basic needs: food, shelter, clothing, health, education. Any process of growth that does not lead to their fulfillment - or, even worse, disrupts them - is a travesty of the idea of development". Nearly 4 decades later our society appears not to have appreciated the importance of this declaration, and is still focusing on GNP maximising paradigm.

It is also appropriate here to note that UN Secretary-General's High-level Panel on Global Sustainability in its report "Resilient People, Resilient Planet: A Future Worth Choosing" launched on 30 January 2012 in Addis Ababa, has strongly advocated for such a path of sustainability.

It may be seen as an irony that while our 5,000 year old civilization had always advocated a sustainable life style and living in harmony with the nature, and while many parts of the world are talking increasingly in these terms, we have chosen a path of GDP centred economic development ignoring our own civilisational values. The time may not be too far away when other countries start preaching us these very values.

It is also the appropriate time to review what the STATE seem to have taken upon itself the obligation of supplying everything its citizen may desire. Why should it be the responsibility of the STATE to supply electricity to decorative/luxurious/wasteful

Resilient People, Resilient Planet:
A Future Worth Choosing
(http://www.un.org/gsp/sites/default/files/event_attachments/Addis%20Launch-Press%20Release.pdf)

"Eradication of poverty and improving equity must remain priorities for the world community,"

"We need to chart a new, more sustainable course for the future, one that strengthens equality and economic growth while protecting our planet,"

"Resilient People, Resilient Planet" calls for the integration of social and environmental costs in how the world prices and measures economic activities. It also calls for a set of sustainable development indicators that go beyond the traditional approach of Gross Domestic Product and recommends that Governments develop and apply a set of Sustainable Development Goals that can mobilize global action and help monitor progress.

applications such as vulgar illumination of private buildings OR reprehensible demand of few million units of electricity a year to multistoried houses of rich people (as reported about such a house of an industrialist in Mumbai) OR night time cricket matches of affluent cricket bodies (who can afford to generate their own electricity on roof tops of cricket stadia) OR a 24 hour shopping mall with central air conditioning OR the air conditioning needs of a building which may have only glass façade for decorative purposes OR night time golf tournament (which was reported to have been held few years ago) OR a heated swimming pool OR a luxury resort etc. In this regard the STATE has a constitutional obligation to protect the legitimate interests of the vulnerable sections of the society, flora and fauna (from the ravages of the large power plants) than supplying the ever escalating demand for electricity from such people/organizations. Electricity for all such decorative /luxurious /wasteful applications should come from renewable energy sources at the same premises of such applications. There is a need for societal level discussions as to what should be the role of the STATE in the case of such non-essential demand for electricity, water, diesel/petrol, cement, steel, land etc. as compared to protecting the fundamental rights for clear air, water, food etc. of the weaker sections of the society; and the right to exist for flora and fauna.

2.9 What could be the minimum per capita electricity demand?

The economic and welfare benefits, which our society can reap from the careful usage of electricity @ per capita production of

1,000 kWH at the national level by year 2070, can be adequate for an acceptable level of HDI, and at the same time may be able to conserve our environment at a satisfactory level. In this context it seems credible to suggest that the projected per capita electricity production of 2,000 kWH by 2070 by Dr. Sukhatme is not only not frugal, but cannot be seen as sustainable either. Most importantly, it does not seem to be necessary. The grave implications to our society of increasing the installed production capacity from the present level to about 3,400 BU by year 2070 (about 64% of which are projected to be through fossil fuels and nuclear power as indicted by Dr. Sukhatme) must be taken cognizance of.

As compared to the projection of total electricity production requirement of 4,793 BU by 2031 by Ministry of Power; 3,880 BU by 2031 by IEP; and 3,400 BU by 2070 by Dr. Sukhatme, the projection of 1,700 BU by 2070 @ 1,000 kWH per capita for a population of 1.7 Billion may seem inadequate without a rational analysis of the ground realities in the country. But it should be noted that it amounts to twice as compared to the actual generation of 811 Billion Units in the country during 2010-11. As mentioned in the above discussion this much of total electricity can lead to adequate level of HDI of our communities, provided we take all appropriate steps for the responsible usage of electricity as a national asset. Any additional electricity requirement at individual households level OR individual enterprise level OR individual community level should come out of dedicated renewable energy sources. The focus should be to minimise the grid based electricity production so that the social, economic and environmental impacts of energy usage is kept to the lowest possible levels.

“Electricity for All: Ten Ideas towards Turning Rhetoric into Reality”: is a discussion paper by Prayas Energy Group, Pune, which has identified 10 steps to overcome the power crises in the short term. This discussion also indicates that a lot more electricity can be made available for welfare of our masses if the power sector is made efficient and socially responsible[2.10].

Our society has no alternative but to take such tough decisions and measures to ensure true welfare of our communities while doing our best to contain the Global Warming.

In the background of all these glaring issues, it would tantamount to letting down the public if the STATE continues to spend lakhs of crores of rupees of the state’s revenue and precious natural resources in establishing large number of additional conventional power plants without harnessing all the techno-economically benign alternatives first.

In view of the enormous potential of a good combination of small

scale isolated renewable energy sources and grid based renewable energy sources to meet our future electricity demand, the society should seek a carefully derived action plan to do away with all the conventional power plants, including nuclear power plants, in a definitive period, say by year 2040, so as to achieve a smooth change over to renewable energy era. In this context the real need for every power project, which is either being proposed or built, must be objectively reviewed from this long term plan. If such an objective review is undertaken, it is highly likely that most of these projects will turn out to be unnecessary.

Our society needs much more holistic approach than the conventional methods of demand projection in order to move towards a sustainable action plan for the welfare of all sections of our society. We can choose either a carefully thought out strategy of responsible demand side management and sustainable energy supply options, OR allow the things to drift by the unlimited energy demand, and face all the associated serious consequences through the continued use of fossil fuels and nuclear power.

In view of the importance of the accuracy of demand projection the Government of India should consider adopting Swiss challenge method in demand projections. The person or agency whose demand projections match with reality for the next few years can be given an award.

Reference material

2.1: "THERMAL POWER PLANTS ON THE ANVIL: Implications and Need for Rationalisation" ; Prayas Energy Group, Pune, Aug 2011

2.2: "Report on Seventeenth Electric Power Survey (EPS) of India"; Central Electricity Authority, Ministry of Power, Govt. of India;

2.3: "Economics of Hydro power", Bharat Jhunjhunwala, Kalpaz Publications

2.4: "Hiding Behind the Poor", GreenPeace India; www.greenpeaceindia.org

2.5: "Still Waiting", GreenPeace India, www.greenpeaceindia.org

2.6: "Power sector reforms: a pilot study on Karnataka", http://www.indiaenvironmentportal.org.in,

2.7: "Energy Savings Potential In Indian Households From Improved Appliance Efficiency", Prayas Energy Group, Pune

2.8: Seminar proceedings on "Programme on Conservation of Energy in Agricultural Pumping Systems" (Sponsored by Ministry of Power, GOI) in June 1999, Central Institute For Rural Electrification, Hyderabad)

2.9: "Meeting India's future needs of electricity through renewable energy sources"; Dr. S. P. Sukhatme, Indian Institute of Technology, Bombay; CURRENT SCIENCE, VOL. 101, NO. 5, 10 SEPTEMBER 2011

2.10: "Electricity for All: Ten Ideas towards Turning Rhetoric into Reality" : A

Chapter 3

Heavy reliance on coal power

– compromising on welfare & sustainability

Key terms: holistic approach, conventional energy sources, energy mix, base load power plants, GHG emissions, consumption pattern, peak demand management, installed capacity, integrated grid, pollution, ecology, coal based power policy, displacement, acid rain, flora& fauna, National action Plan on Climate Change, Ultra Mega Power Projects, social and environmental costs

Chapter Summary

Coal, as a fossil fuel, is fast running out, and is encountering a lot of issues from the stiffening environmental regulations to the escalating price and decreasing reliability of supply. The popular oppositions around the world to the coal mining and coal power plants are escalating because of the recognition of social, economic, environmental and health issues. Its global warming potential is acknowledged as huge, because of which there are persistent calls for early retirement of coal power plants. India, being one of the largest producers and users of coal, has to address the credible concerns of its teeming millions. Even from technical and financial angles coal cannot be portrayed a role in our future energy scenario. It is difficult to see reason for any optimism on the coal supply front. One can expect a lot of stranded assets in coal power generation, along with huge burden to the society, if necessary steps are not taken to rationalize our generation planning strategy.

The most disappointing aspect of IEP is the absence of holistic approach to different aspects of various energy sources from a societal perspective. In general only the technical, financial and logistics issues seem to have been considered leaving out the social and environmental issues. It is difficult to imagine how such a narrow approach can become the credible basis for a crucial national level policy.

As per IEP coal emerges as the most important energy source for India accounting for not less than 41% of our energy mix under any scenario and potentially reaching 54% of energy mix under certain scenarios by 2031-32. It says that even at the 41 % level, India will

need 1.6 billion tons of coal annually by 2031-32, which is about 4 times the domestic production in 2005. In IEP's projection coal may represents 46% of all the commercial energy and 53% of the conventional energy sources for the scenario in 2031-32. The projected coal power capacity by 2031-32 is about 320,000 MW including coal bed Methane and in-situ coal gas. The second column in table 3.9 of IEP indicates only a total installed capacity of 700,703 MW. Whereas the total installed capacity in 2031-32 as per IEP should be 778,000 MW, this figure of 700,703 MW leaves a gap of about 78,000 MW, which can be assumed to come from coal power. Hence the total coal power capacity by 2031-32 as per IEP projection can be assumed to be about 400,000 MW. This means an increase of about 5 times over 80,000 MW installed coal power capacity as at 2005.

As mentioned in the previous chapter a survey report by Prayas Energy Group released in 2011 (Ref. 2.1) has estimated that there are more than 700,000 MW of coal and gas plants waiting to be built in the coming years. From the perspective of massive economic, social & health, and environmental issues associated with coal power the vast addition proposed should be a matter of great concern to the Civil Society.

Table 7: Major issues with coal based power policy

Economic	Puts huge pressure on natural resources such as land, water and minerals; demands a lot of construction materials like cement, steel, sand; will increase average cost of power; road and rail transportation infrastructures need a lot more strengthening; pressure on ports will increase due to the need for import of coal; land costs around coal power projects will become unaffordable to locals; overall efficiency from coal energy to end use of electrical energy is very poor of the order of about 10% only.
Social and health	Peoples' displacement will cause additional unemployment & increase in slums; will affect agricultural production and health; prospect of displacement will create social tensions and stiff opposition; local buildings of heritage importance will degenerate; nearby places of tourist and religious importance loose prominence; causes serious erosion of local community development; livelihood and drinking water needs of the local communities will be threatened. Coal plant emissions contribute to some of the most widespread diseases, including asthma, heart disease, stroke, and lung cancer
Environmental	Safe use for all the ash generated is not available yet; acid rain will affect flora and fauna including forests and agricultural crops; coastal power plants will affect marine creatures; destruction of forest lands to open more of coal mines; have to contend with nuclear radiation in coal ash; credible threat to bio-diversity; fresh water sources will be polluted; reduces the access to fresh water sources near mines; huge contribution to Global Warming and Climate Change; negates the purpose of National action Plan on Climate Change.

When we consider the projected massive increase between 2006 and 2031-32 (of about 30,000 – 50,000 MW a year) in the context of a total installed coal power capacity of about 90,000 MW between 1947 and 2011, the enormity of problems to our community and environment will become obvious. None of the official reports which have either advocated for such a massive increase OR projected such a massive increase seem to have considered the deleterious impacts on the society. If the vulnerable sections are impoverished by such power electricity projects, the very purpose of them will be defeated.

3.1 Technical

A fundamental issue associated with coal based power policy seems to have been ignored by IEP. Whereas coal power plants are base load power plants, requiring power production at maximum level to be economical, the demand projection in different regions of the country indicate that the deficits are more during peak demand hours than in the annual requirement of energy.

Table 8: Power Supply Position in India (Year 1996 to 2009)

	Annual Energy Demand (MU)			Annual Peak Demand (MW)		
	Demand	Supply	Deficit	Demand	Supply	Deficit
1996-97	4,13,490	3,65,900	11.5%	63,853	52,376	18.0%
1997-98	4,24,505	3,90,330	8.1%	65,435	58,042	11.3%
1998-99	4,46,584	4,20,235	5.9%	67,905	58,445	13.9%
1999-00	4,80,430	4,50,594	6.2%	72,669	63,691	12.4%
2000-01	5,07,216	4,67,400	7.8%	78,872	65,628	12.3%
2001-02	5,22,537	4,83,350	7.5%	78,441	69,189	11.8%
2002-03	5,45,983	4,97,890	8.8%	81,492	71,547	12.2%
2003-04	5,59,264	5,19,398	7.1%	84,574	75,066	11.2%
2004-05	5,91,373	5,48,115	7.3%	87,906	77,652	11.7%
2005-06	6,31,554	5,78,819	8.4%	93,255	81,792	12.3%
2006-07	6,90,587	6,24,495	9.6%	100,715	86,818	13.8%
2007-08	7,37,052	6,64,660	9.8%	108,866	90,793	16.6%
2008-09	7,77,039	6,91,038	11.1%	109,809	96,785	11.9%

[Source: Union Power Ministry]

A recent power demand /supply scenario in the country is shown in the two tables 9A and 9B. It can be seen that the deficit during peak hour during 2011-11 was 10.3% whereas the deficit for the year was 8.5%. This scenario is generally true in most of the recent years as in table 8. Hence building large coal based power capacity may not exactly fit the power scenario in all states/regions.

A simulation study by D. Narasimha Rao, Visiting Faculty, IIM Bangalore in May 2006 for the state of Karnataka has revealed that building a number of coal based power plants, as proposed in Karnataka at that time, would result in excess base generation

capacity by year 2015, and was likely to result in overall thermal PLF of less than 35%. Such a low PLF will not only be disastrous economically but clearly will not be in the interest of the society. With changing electricity consumption pattern, the focus on peak demand management, and increased awareness on GHG emissions etc., due diligence is needed to ensure that excess base generation capacity will not result in any state/region. There may be arguments that the surplus in base generation capacity of one state can be made use of by other state/s through the grid. In this context a question needs to be asked whether it is worth setting up excess coal power capacity, at great societal cost to a given state, only to export excess power to another state. It is not clear from IEP report whether such a situation has been considered carefully.

The inefficiency prevailing in the power sector may be exemplified by the deficiency in optimizing the installed capacity. Table 5 in section 2.6 throws light on such a deficiency. A high level analysis indicates that whereas the total installed capacity in 2011 was about 177,000 MW from various sources, and whereas about 155,000 MW should have been available as peak power (after allowing for auxiliary consumption and unplanned outages as per CEA norms) in a normal situation, the peak demand met between April 2010 – March 2011 was only about 112,000 MW (as per table 9A); a deficit of about 10%. Even if we accept that hydro capacity may not be maximum at the time when thermal power output is maximum (due to irrigation requirements), and the low PLF of renewable energy sources, the maximum power available during this period could have been not less than 130,000 MW. If this expectation was to be met there need not have been any peak hour deficit at all during that period. This analysis may generally hold good at other times of the year and in most years. So the question is why is even the peak hour deficits reported year after year? The obvious reason could be the poor performance of many power plants, especially in the state sector. It is reported that many older coal power plants in state sector are operating at very low PLF of 25 - 30% year after year. If such old power plants are replaced by modern plants (in the same locations) with much higher efficiencies, the power deficits can be overcome, and hence there may not be the need to build so many additional coal power plants.

Table 9A: Power Supply Scenario (April 2010 – March 2011)

	Peak Demand (MW)	Peak Demand Met (MW)	Peak Deficit (%)
Northern Region	37,431	34,101	8.9
Western Region	40,798	34,819	14.7
Southern Region	33,225	31,129	6.3
Eastern Region	14,528	13,085	9.9
N E Region	1,913	1,560	18.5
Total for the Country	125,077	112,167	10.3

(Source: Central Electricity Authority)

Table 9B: Power Supply Scenario (April 2010– March 2011)

	Energy Requirement (MU)	Energy Availability (MU)	Energy Deficit (%)
Northern Region	259,426	238,782	8.0
Western Region	268,452	232,835	13.3
Southern Region	229,853	217,929	5.2
Eastern Region	94,515	90,458	4.3
N E Region	9,879	9,009	8.8
Total for the Country	862,125	789,013	8.5

(Source: Central Electricity Authority)

Whereas a predominant role for coal has been envisaged during next two decades in the country, and possibly beyond, the logistics and economics of ensuring adequate quality/quantity of such huge quantities of coal is not discussed adequately in IEP. The largest user of coal, NTPC Ltd, has been complaining for a number of years that coal supplies to its thermal power plants were inadequate. Few years ago, the minister of State for Coal is reported to have said: "There are no two opinions about the need to switch over to other modes of power generation ……. Coal-based power production has to be restricted". Coal ministry officials claim that the demand and supply of coal to the power plants was going to run neck to neck in times to come. This only indicates the seriousness of the problem of reliable coal supply even for the existing power plants.

India at present has approximately 90 coal-based thermal power plants, out of which about 80 are known to be supplied by Coal India Limited (CIL). With so much of coal supply responsibility with just one state owned public enterprise, it is anybody's guess as to how the reliability of coal supply is likely to be if our coal power capacity is to be increased by 4 or 5 times. The railways are already struggling to carry coal to power stations on a reliable basis. If the proposed coal production target were to be realized it is difficult to imagine the chaos in the transport sector to move coal from one part of the country/ port to the power generation sites. As indicated by the IEP even if 15 to 20% of the total quantity of coal required to support such a huge installed capacity by 2031-32 is to come from overseas, the need to set up additional port facilities, environmental impacts of the same and the stress on the road/rail infrastructure to carry the coal from these ports will be huge, which have not been discussed in IEP.

The IEP projects the requirement of coal for power generation to increase from 406 Mt in 2004–05 to 2,555 Mt in 2031–32. Since the domestic supply of coal is limited, IEP projects that upto 45% of the coal requirement in 2031-32 would need to be imported. The

problem is: globally available exportable coal supplies are also running out! A recent study by the Energy Watch Group of Germany predicts that global coal production will increase over the next few years, peak around 2025 and then decline. Clearly then, it is foolhardy to base our future energy security on a resource whose domestic supplies are hard to increase and the global availability of which in adequate quantities beyond 2030 is suspect.

IEP has admitted that the coal reserve in the country is not huge as was thought few years ago. It says that if the domestic coal production continues to grow at 5% per year, all the total extractable coal reserves (including proven, indicated and inferred) will run out in about 45 years. At the escalating rate of coal extraction (as indicated by licenses being awarded for additional coal mines) it is anybody' guess whether the economically extractable coal will last even for 25 years. As a policy document IEP has failed in taking a longer term view of considering what would happen to energy security for the country after 45 years if we continue to relay so heavily on coal; because there are no clear recommendations to find a substitute for coal by the time when we are likely to run out of coal.

An announcement in 2010 by Environment Ministry (MoEF) has indicated that about 33% of all coal reserves in the country are below very thick forests, and hence will be 'NO GO' areas for mining. The level of indifference to the ecological wellbeing of our communities was exhibited by our leaders when some political leaders and industrial houses launched a concerted opposition to MoEF's suggestion on 'GO' and 'NO GO' areas in the forests for coal mining. In this context it is not clear as to how large quantity of additional coal supply can be ensured. In a clear admission of the natural limit to conventional coal mining, IEP has discussed few other coal related options such as coal bed methane, in-situ coal gasification and coal liquefaction, but also recognizes that these technologies are still in nascent stage.

While the projection of 5 times increase in coal power capacity by 2031-32 (as per IEP) gives rise to huge socio-ecological concerns, the gross inefficiency associated with the coal energy chain itself is shocking. Whereas the thermal efficiency of coal fired boilers, to convert coal energy to steam energy, is in the range of 28-31% in India, the best technology available can take it to a maximum of about 40% as per IEP. With station auxiliary consumption of about 10-12% for Indian coal power stations, transmission and distribution (T&D) loss of about 25%, and huge inefficiency in end use applications, the overall efficiency of using coal energy to productive/economic end use can be less than 10%. This is in stark contrast to 12 -15% efficiency of solar photo voltaic (SPV) panels already in commercial use in the country. It is also reported that 20-25% efficiency of SPVs has already been achieved in laboratory conditions using new materials. In this regard IEP has ignored the apparent benefits of solar PV panels as compared to coal power, especially in view of the huge socio-ecological costs of coal power.

Classical power plant economics indicate that a coal power plant is optimally economical if it is located either at coal pit head or close to the electrical load centre. But due to sheer absence of a rational approach most of the coal power plants are coming up at places far away from these locations and even at places not suitable for coal power plants. Since a substantial number of coal power plants already in operation and being proposed are neither at coal pit head or close to the electrical load centre, the true economics of such power plants can be questioned in the context that such plants have to incur both the cost of transportation of coal over long distances from the mines, and also lead to higher transmission losses.

3.2 Issues of supply and economics

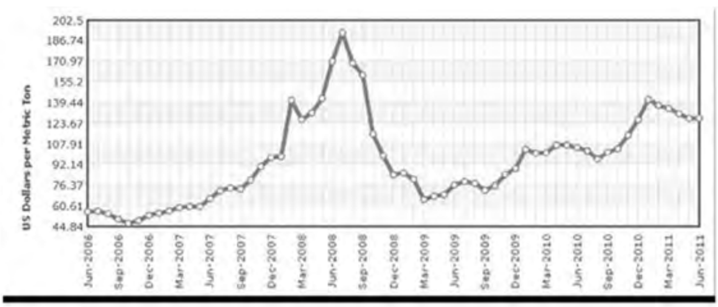
In the context of the inability of the domestic coal industry to supply the required volumes of coal on a reliable basis, an increasing number of coal power plants, including some of the older ones, have started importing coal from Indonesia, South Africa, Australia, and USA. Some of these power plants have reported to have as much as 20% blending of imported coal with domestic coal. Many of the coastal based Ultra Mega Power Projects (UMPP) have plant design entirely relying on imported coal. Two such UMPPs (one each in Gujarath and Andhra Pradesh) already have been seriously impacted by the risks/uncertainties associated with the international coal market in the form of supply disruptions and steep increase in prices.

The commercial impact of increase in coal price on these UMPPs has been reported to be so much that one of the project has stopped the plant construction, and the other has postponed the commissioning of its first generator. Ministry of Power (MoP) has also been requested to assist in the renegotiation of price for the supply of power from these plants. In view of many reports from across the globe about local movements against coal mining (such as the ones in Appalachian Mountains in USA, and Queensland in Australia), and the development that countries like Indonesia have brought legislation to link the export price of coal to international coal prices, the reliability of supply and the predictability of price of coal is in question. The unreliability associated with the import of coal was highlighted by the sinking of a coal carrying ship off the coast of Maharastra in 2011. The opposition to opening of additional coal mines in India also has become severe as noticed in Orissa, Chattisgarh and Madhya Pradesh. The popular opposition to set up huge number of coal power plants in small geographic areas such as coastal Orissa, Andhra Pradesh, Konkan, Vidarbha, and Chattisgarh are clear indication of the people's sentiments against the coal power plants.

International Energy agency (IEA) has said, in its report ('Medium-

Term Coal Market Report 2011 -- Market Trends and Projections to 2016') : " Despite public calls in many countries for reducing reliance on coal as a primary but high-carbon energy source, global demand continues to escalate. Coal has traditionally been seen as a low-cost and price-stable source of energy, but recently coal prices have increased and become much more volatile. Moreover, while coal is viewed as a very secure energy source, infrastructure bottlenecks and weather-related events can dramatically tighten the market."

Steep Rise in Coal Price



(Source: Sierra Club, Washington DC)

NTPC is reported to be blending imported coal between 7 and 20 per cent across its various stations. According to industry estimates, in about five years, India could be forced to import almost 30 per cent of the total coal required by its power plants, compounding the financial worries for distribution utilities at large. The ever increasing prices of both domestic and imported coal will cause havoc on the financial status of power companies in the country.

Recently (Jan. 2012) there were reports that the power price in the country is likely to go up by 60 Paise per unit in a single increase very soon due to increase in domestic coal price. While there has always been uncertainty over pricing of coal in recent years, because of the move by CIL recently (in Nov/Dec 2011) to adopt Gross Calorific Value method and the weakening of the rupee (about 20% rupee depreciation in the six months upto Nov/Dec 2011) the issue acquired a crisis proportion. The bills of companies subsequently increased by 30-40% because of GCV mechanism and weak rupee are expected to increase it further. This situation is expected to affect projects which are based on imported coal. In 2011 the union government has levied a cess of Rs. 50 per ton of usage of all types of coal in the country for creating carbon mitigation fund. It will not be a surprise if the

effective price of coal across the globe keeps increasing for similar reasons more often than ever. The losses suffered by the country's distribution utilities, which are estimated to have exceeded Rs 100,000 crore in 2010-11, will go up further due to increased coal prices unless suitable remedial measures are taken.

In a statement as reported by Business Standard on 31st Jan. 2012, NTPC's Chairman and Managing Director Arup Roy Choudhury is reported to have stated that NTPC is not in favour of ramping up its coal imports as this would escalate the cost of electricity. NTPC is reported to be importing about 16 million tons of coal per year to meet its demand in recent years.

The probability of additional pollution taxes on coal usage in India is increasing because of domestic & international pressure to tighten the environmental regulations. China, which is the biggest user of coal, was reported in Jan. 2012 to have taken a decision to impose additional pollution tax starting from 2015 with initial level of $1.55 a ton of carbon dioxide emission. A senior Chinese official was reported to have said that under the proposal the tax rate would increase gradually, and that the pollutants such as sulphur dioxide and nitrogen oxide, and COD (chemical oxygen demand) as a measure of pollution would be the first to incur tax and, as conditions matured, other emissions would be included.

Even those coal power plants, which are relying on domestic coal, are facing highly unreliable supply. The Central Electricity Authority (CEA) reports indicate that during the last few years the loss of electricity production due to coal supply problems has been increasing. As per the Standing Committee of the Parliament on Energy, the shortage of coal is expected to impact new capacity addition plans to the tune of 15,000 MW in the fiscal year (2011-12). If NTPC, the high profile central govt. undertaking, cannot ensure adequate coal supply to its plants, one can imagine the plight of other state owned/private companies. Karnataka's Raichur TPP has been known to be facing coal shortages for years. The proposals by Karnataka state govt. to set up additional coal power plants are halted because of the lack of coal linkage. The states like Karnataka, which have no coal reserve of their own, and are already stressed water states must be extremely reluctant to go for additional coal power plants. The overall costs to the society of an UMPP such as the one proposed near Bijapur in Karnataka can be huge while the net benefits may be meager. For these states there are very many benign alternative options available to meet the legitimate demand for electricity.

In an interview in January 2012, the Chairman and Managing Director of NTPC was reported to have said that his company with 36,014 MW power capacity may be experiencing power generation

loss of 10-15 % every year due to insufficient supply of coal. Many states and private companies also are known to be experiencing the same problem.

In this background there should be no doubts that coal supply situation in the country has become a major problem. Despite concerted efforts by the union govt. to dilute the existing environmental regulations to allow opening up of more coal mining, the coal supply situation is highly likely to go from bad to worse for a combination of reasons. Even some of those new coal mines, for which approvals have been accorded, have not got to the development stage due to various reasons. The coal ministry is reported to have withdrawn the allocation of 3 new coal blocks to a large public sector power company because the development of these coal mines was not undertaken within the stipulated period.

In the months of October to December, 2011 almost all coal power plants in the country suffered hugely because of inadequate supply of coal due to flooding of coal mines in the east, agitation in coal mining, and shutting down of mining in Andhra Pradesh due to Telangana agitation. Indian railways, which transport most of the coal within India, is already known to be stretched in its infrastructure to supply the required amounts of coal on a reliable basis. It is only natural to expect that such problems in coal supply will become more critical with huge number of coal power plants being planned all over the country.

This coal supply situation is also consistent with what is happening all over the world. The true cost of coal power is coming to the surface, and the fact that the global coal reserve/mining cannot match the maddeningly increasing number of coal power plants is no longer questioned. Though the industry observers have been warning of this situation and the need to shift to suitable alternative sources of electricity since many years, the governments all over the world ignored the writing on the wall. Now the situation is rapidly growing to be a crisis as being reported from many parts the world.

A report in www.bloomberg.com on Jan. 18, 2012 has reported that the promoters and executives, together accounting for about 42,000 MW of coal power capacity, or about one-fifth of the country's total generation capacity, met the PM and his senior ministers to express their concerns over the rising cost of imported coal, concerns over availability of funds, uncertainty and delays in environmental clearance besides shortage of coal and gas. The report also said that the Tatas, and Adanis have been seeking a revision of tariff (for their UMPPs) since international price of the fuel has risen substantially in recent times.

In another article 'India's Richest Delay Power Plans in Setback to Prosperity for All: Energy' , on Jan 18, 2012, www.bloomberg.com/news has reported that "Soaring coal prices across Asia have led India's richest families to shelve plans for a record $36 billion investment in new power stations needed to fuel growth in the world's second-fastest-growing major economy".

With Indian thermal power projects facing environmental hurdles and coal-linkage issues, banks are reported to be very hesitant in advancing loans to coal fired power plants, and instead are increasingly warming up to project proposals from the non-conventional (solar and wind) energy sector. There are also reports that a number of the Indian companies that were pushing for new coal plants (to get CDM credits) only recently, are now applying for solar power projects under the national solar mission.

IEP recommendations seem to encourage even those states with no coal reserve to opt for coal power plants. Many states like Karnataka and Kerala, which have no coal reserve and which are also facing acute crises in fresh water supply, appear to be on an overdrive mode to set up coal power plants within their states without objectively considering any of these issues. Even the Himalayan state of Himachal Pradesh was also reported to have considered planning to build a coal power station.

A recent article in The Economist has discussed in detail the bleak future facing the coal power sector in the country due to multiple reasons. In the article "The future is black" (Jan 21, 2012) it says 'Power is essential for India's long-term growth. But electricity is unlikely to flow fast enough.' The gist of this article is consistent with what has been said in the earlier paragraphs, and unambiguously indicates that the coal based power cannot be a reliable and satisfactory option for the country.

A news item in Times of India on Jan 25, 2012 "Get ready to pay more for power" has indicated that as a result of the new coal-pricing regime to be implemented by Coal India, may push up coal prices between 50% and 180%, and the that the cost of generating electricity would rise 35%.

An article by Sierra Club, USA can be seen as summarizing the whole story about coal power sector in India. In an analysis of coal power sector in Asia, Sierra Club, USA on 25 January, 2012 has indicated how the coal power sector can become a "The Carbon Noose Around Asia's Neck". It has quoted many reports on the subject, and indicates that the combined oil and coal imports bill for India in 2011, relative to India's economy, is four times as large as the American oil imports drain (Annexure 2).

A press release from Sierra Club, USA on January 26, 2012 indicates that "First Energy" (a leading power producer in USA) has announced that it will retire six of its dirtiest coal-fired power plants located in Ohio, Pennsylvania, and Maryland, by September 1, 2012. This decision by a single energy company to retire 2,700 MW of coal power within 7 months should be an important lesson for our society as to how we should be respecting the health of our communities.

Another article in The Economist (Jan 28, 2012), "A burning issue" has discussed the problems facing coal power in USA. It indicates, among other things, that due to tighter regulatory issues and the comparatively lower costs of natural gas and renewables the share of coal power can come down from 45% (of the total installed power capacity in USA) in 2010 to 20% by 2030. The article has shown that the two states (Kentucky and West Virginia) found in recent years that the coal industry has become a net cost to the state. Hence even the argument that coal power can be a net revenue earner for some states also has disappeared. It also refers to a National Academy of Sciences report which has estimated that the external costs unrelated to climate-change costs (such as human health, crop and timber yields, building materials and recreation) of coal-fired power plants of US in 2005 was abut $62 billion.

If our society cares to build all such externalities into coal power price, the true price of electricity may become many times more than what it is being wrongly indicated now. Even if all possible efficiency improvement measures are implemented in the power sector, the true cost of coal power is likely to be much higher than it is now.

In the last week of January 2012 the coal minister is reported to have sent a letter to the power ministry requesting an immediate freeze in the pipeline of coal projects. His reason – the Coal India limited (CIL, world's largest coal miner) is unable to ensure adequate supply of coal and therefore the financial health of the coal projects in pipeline. Almost immediately after CIL announced its desire for a freeze, the Reserve Bank of India (RBI) followed suit by suggesting banks freeze lines of credit for this "distressed sector". The move followed months of warnings from financial analysts that systemic defaults loomed on coal plant loans and the widespread impact it would have on Indian banking sector due to high exposure. All these issues are pointing to a looming crisis, which the society should not ignore. It may be a useful lesson for India to note how a somewhat similar situation in US unfolded. It is critical to note that there was no discernible impact on the power supply scenario in US despite none of the 180 power plants (totaling to about 100,000 MW) proposed between 2001 and 2010

are going ahead.

In this context it is interesting to note that Power Finance Corp., India's largest state-run lender to electricity utilities, plans to more

Sierra Club's India Environment Post: 7 February 2012
"Between 2001 and 2010, the U.S. almost locked itself into a generation of 180 costly and unneeded coal-fired power plants. Campaigns led by the environmental community, the enacting of state renewable energy standards, and more-abundant competitive sources like wind and natural gas, headed off that almost catastrophic coal rush. Now Asia faces a similar choice -- overbuild coal plants and guarantee bloated prices that will depress its economic potential, or pivot away from reliance on new coal and start deploying the new, low-cost power leaders -- efficiency, distributed generation, wind, and solar."

than double lending for renewable energy projects within a year as coal-fired plants become riskier investments (http://www.businessweek.com/news/2012-02-06/renewable-energy-s-funding-to-be-doubled-by-indian-state-lender.html).

This is the right time for India to take all possible steps to diligently review the true need for the vast number of coal power plants which are waiting in the pipeline. A modest understanding of the ground realities of coal industry around the world and constraints within India can lead us to predict that this situation of unreliable supply and unpredictable price of coal will continue to haunt the power companies in India for many years to come, if at all it can be resolved satisfactorily ever. In this context we have to review the true need for the large number of additional coal power plants being issued with environmental clearances in the country. It will be a reasonable question as to how the legitimate interest of our people can be protected by continuing to rely on such a risky/costly source of power as coal.

The Indian Express in a news item of 20 June 2012 "Coal supply low, power projects of over 32,000 MW shelved, delayed" has reported that over 32,000 MW of upcoming coal-fired thermal power generation capacity has either been shelved or simply put on hold by project developers until June this year. This is about 50 per cent of the government's estimated capacity addition for the twelfth five year plan. Apart from concerns on adequate coal supplies for new projects, there are also increasing signs that developers of projects close to commissioning could default on loan repayments due to fuel shortage, resulting in a heightened sectoral risk perspective.

IEA's recent report has highlighted: "US emissions have now fallen by 430 Mt (7.7%) since 2006, the largest reduction of all countries or regions. This development has arisen from lower oil use in the

transport sector … and a substantial shift from coal to gas in the power sector."

In the USA, the Sierra Club's Beyond Coal campaign has become a hugely mobilized and successful campaign that is reported to have helped stop more than 150 proposed coal plants and helped retire more than 100 old and inefficient coal plants. Duetsche Bank has said: "Banks won't finance them. Insurance companies won't insure them. The EPA is coming after them…And the economics to make it clean don't work."

IMF chief Christine Lagarde was reported to have said on June 12, 2012 that the pollution from coal generation plants causes about 70,000 premature deaths every year in India. (http://www.firstpost.com/india/coal-pollution-causes-70000-deaths-a-year-in-india-imf-chief-341271.html)

3.3 Clean coal technologies and Clean Development Mechanism (CDM)

The coal industry is trying hard to neutralise the Civil Society criticisms on environment and health issues by advocating clean coal technologies such as Carbon Capture and Storage (CCS), coal gasification, Integrated Gasification Combined Cycle (IGCC) etc. The additional costs due to such technologies are proposed to be recovered by a mechanism called CDM.

The reality behind the hype over clean coal technologies (such as CCS), is mentioned in Annexure 3. It becomes obvious that the environmental issues of coal burning can only be reduced to some extent, but pollutants and other related issues will continue to haunt us. The initial reports on CCS technology indicate that there are huge cost implications; and because of an estimated additional energy requirement of about 33% in running the associated processes it may mean having 33% more power plants to provide energy to these technologies. Few recent developments (as in the box item below) may indicate the difficulties associated with the hype.

IEP itself refers to Clean Coal Technology as a way forward for the country to be able to produce more power and also to reduce the pollution from coal burning. It advocates high emphasis on R&D for developing new generation technologies. These include coal technologies for efficiency improvement; in-situ gasification; IGCC and carbon sequestration. While such technologies may help in reducing the particulate emission associated with mining and burning of coal, scientists are of the opinion that it is impossible to contain various GHG emissions under the ground permanently.

A report from Reuters Africa on Dec. 5, 2011 says: Swedish utility Vattenfall on Monday abandoned plans for a 1.5 billion euro ($2 billion) carbon capture and storage (CCS) pilot project in Germany, due to popular opposition based on environmental fears. In October, a row between the UK government and Scottish Power, owned by Spain's Iberdrola, led to a cancellation of a 1 billion pound CCS demonstration plant at Longannet in Scotland after the British government withdrew funding. Analysts said the withdrawal signalled that the technology remains too costly and that it undermined Britain's ambition to become a clean technology leader. As a result, Britain is unlikely to see commercial CCS projects by 2020, and the government should devise a plan to reach climate targets by the end of the decade without CCS, a UK parliamentary committee stated in a report.

A major concern with all these technologies is that the CO_2, which is intended to be stored in deep caverns in liquid/solid/gaseous form, may leak out to the atmosphere some where some time later, and also pollute fresh water sources. There does not appear to be a great deal of confidence amongst the scientists that these technologies can address all the concerns associated with the coal burning.

A feeble attempt seems to have been made in IEP to address the environmental impacts of coal power plants by advocating clean coal technology. The commonly known understanding of clean coal technology is that the GHG emissions from such a technology will be less than the conventional technology, but the GHG emissions and pollutants cannot be completely eliminated. Literature search on clean coal technology indicates that it is an umbrella term used to describe technologies being developed which aim at reducing the environmental impact of coal power plants. Such a technology may make coal a fuel source that is very low in carbon dioxide emissions and other pollutant emissions, but many other pollutants will remain a source of major concerns. The additional energy requirements of Carbon Capture and Storage (CCS) or Carbon sequestration itself is estimated to be about 33% of the associated plant capacity, and also is expected to cost considerably, probably to make the coal power unviable. [3.1].

Even if Clean Coal Technology turns out to be techno-economically viable in the near future, there is no escaping the fact that atmospheric pollutants will not be completely eliminated from the coal burning process, and the total GHG emissions from a large number of additional coal power plants will be much larger than the avoided emissions from Clean Coal Technologies.

It seems reasonable to assume that if CCS technology can be deployed cost effectively and be able to contain the GHG emissions within the limits some of the coal power plants may be seen as

acceptable. But on the basis of the information available it appears that they will never be viable because of the energy penalty. Any finance for a coal power project based on CCS technology seems to be very risky, expensive, and unproven technology at commercial scale.

Many new coal power projects seem to have been planned hoping for financial assistance from Clean Development Mechanism (CDM) under United Nations Framework Convention on Climate Change (UNFCCC), on the premise that such new coal power units operate on Super Critical Boiler parameters, thereby bringing down the usage of coal and GHG emissions[3.2]. However, due to massive opposition by environmental groups from across the world, the CDM executive board is under sustained pressure to discontinue coal power plants from the purview of CDM (Dec. 2011). This is on the argument that while coal power units with Super Critical Boiler parameters, may reduce the GHG emissions marginally, CDM benefits to such units will encourage more of coal power plants to come up all over the world with disastrous consequences of increase in total GHG emissions. In this context it is reasonable to predict that even the UMPPs with Super Critical Boiler parameters will face many serious hurdles.

3.4 National and International Agitations against coal power

Greenpeace India, recently (2011) released the results of a fact-finding mission to Maharashtra's Chandrapur region, near the Tadoba-Andhari Tiger Reserve (TATR). As per this report the rapid assessment has revealed that ongoing and proposed coal mining in the area continues to pose a serious threat to tigers by destroying the forest corridors around the reserve. The highlights of the report are: "Chandrapur is symptomatic of the threat that coal mining poses to the tiger and other species in much of central India. It's shocking that even though India's tiger population is at critical levels, the coal ministry is pushing for the destruction of more than six lakh hectares of forests for coal mining. Much of this is habitat for tigers and other threatened species, and essential for the livelihoods of forest-dependent communities. We are here to tell Minister Jaiswal that such brazen forest destruction is no longer acceptable". “More than 26,000 hectares of forest land has been diverted for coal mining since 2007, making coal one of the biggest threats to forests in the country. The coal ministry has been asking for additional forest land to increase coal production in Central India, blaming forest clearance procedures for a shortfall in energy generation. Since Coal India Limited already has access to over 200,000 hectares of coal bearing land, including 55,000 hectares of forest area, there has been speculation that this is a poorly disguised land grab.”

Chandrapur area in Vidarbha region of Maharstra is planned to have many coal power plants within a small geographical area. Naturally a lot of opposition to these power plants has sprung up.

It is reported that due to sustained and concerted opposition by Sierra Club and few other NGOs in USA, about 150 coal power plants were stopped between 2001 and 2010. But for this campaign "Beyond Coal Campaign" 150 coal units would have been built generating over 83,600 MW. The fact that about 83,600 MW of coal power did not get commissioned in a period of about 10 years (when no nuclear power and hydel power units were also built) had no impact on the electricity reliability in USA, is a clear indication that coal power was not critical. Less costly option such as natural gas based power and renewable power seem to have been chosen as the alternative. The same argument may hold good in India too, and hence suitable alternatives should be objectively considered.

3.5 Societal Issues with coal power

An argument being offered by the proponents of coal power is that it contributes to energy access for the poor people and the rural areas. The fact that a massive increase in coal power capacity in the country (an increase by about 90 times) since independence has not ensured access to electricity for a good portion of our population negates such an argument. A new report by Oil Change International, released on the eve of the World Bank's Annual Meetings in 2011, dispels the myth that World Bank support for coal and oil projects increases access to energy for the world's poorest. The World Bank has used arguments around increasing energy access – providing energy to the 1.4 billion people who lack access to electricity or the 2.7 billion still using wood or biomass for cooking and heating – to justify the approval of massive new coal-fired power plants like the Eskom plant in South Africa, as well as the continued funding of oil projects. But both Oil Change International's original research and the Bank's own analysis show that none of the Bank's coal or oil lending for the last two years have prioritized increasing energy access (Annexure 4).

The fact that coal power plants demand large tracts of land is a very disconcerting issue being faced by our communities. It is mostly agricultural lands, on which tribals and other vulnerable sections of our society live on without skills to do anything else for livelihood, which are aimed for acquisition for coal power plants. Because of the threat to their livelihoods and because of the past bitter experience of inadequate compensation (and R&R) such people are reluctant to part with their lands. This situation has led to the revenue and police officials forcefully acquiring lands to help the project developers to set up coal mines and/or coal power plants. Massive oppositions to such forceful acquisitions, subsequent

retributions by the authorities, and suffering by such families are being reported regularly in the media.

One such recent report has been in The Hindu of January 16, 2012 under the title "No public, just hearings for mega projects", which reported on the arrest of 36 men after a public hearing, held to assess the environmental impact of a thermal power plant, turned violent. It says: " … In Korba's neighbouring district of Janjgir-Champa, for instance, farmers are actively resisting 36 coal-fired power plants that seek to acquire close to 40,000 acres. …. documents obtained by The Hindu reveal how officials in Chhattisgarh treat the Environmental Impact Assessment Notification of 2007 and the Panchayat Extension to Scheduled Areas Act (PESA) of 1996 as mere formalities and routinely overrule gram sabhas to acquire lands on behalf of industry, prompting a withdrawal of the 'public' from public hearings." Such incidences are being reported more frequently from coal rich states and costal districts. They should be a matter of great concern in a welfare society.

In a groundbreaking article (Life-cycle study: Accounting for total harm from coal would add "close to 17.8¢/kWh of electricity generated") in the Annals of the New York Academy of Sciences, Dr. Paul Epstein, associate director of the Center for Health and the Global Environment at Harvard Medical School, details the economic, health and environmental costs associated with each stage in the life cycle of coal – extraction, transportation, processing, and combustion. He says that these costs, between a third to over half a trillion dollars annually, are directly passed on to the public. The report says that whereas the average residential price of electricity is 12¢/kWh in USA, the life cycle costs (total economically quantifiable costs) of various social and health costs may add about 17.8¢/kWh.

A report from Reuters (Feb. 16, 2011) has quoted a US study and said : "The United States' reliance on coal to generate almost half of its electricity, costs the economy about $345 billion a year in hidden expenses not borne by miners or utilities, including health problems in mining communities and pollution around power plants, a study found. Those costs would effectively triple the price of electricity produced by coal-fired plants, which are prevalent in part due to their low cost of operation, the study led by a Harvard University researcher found."

In this context it is not very difficult to project that the true cost of coal power in Indian scenario can be few times more than what it is being indicated today. But the externalities associated with health and environment are never taken into account.

As per a report by National Commission for Integrated Water

Resources Development (NCIWRD) India may require nearly 10 percent more water than existing government calculations by 2050 (from livemint.com). Sharad K. Jain, author of the latest study, evaluated that the country's water requirements would rise up to 10 percent to 1,327 Billion Cubic Meters (BCM), as a result of a growing population. Such a 10% increase in fresh water requirement is significant. In this context where water scarcity is anticipated due to population growth, the additional pressure on the fresh water resources due to a massive increase in coal power capacity can cause havoc on our communities.

In this context there is critical need to reassess the true relevance and the cost of a large number of additional coal power plants requiring massive amounts of fresh water. Emerging water shortage scenario should be a grave concern to the society.

Prayas Energy Group's report[2.1] has highlighted many serious issues associated with the large number of proposed coal power plants:

Many of the proposed coal power plants are planned to be concentrated in 3 or 4 geographical areas in the country. Of the 700,000 MW projects in MoEF pipeline, more than half are expected to come up in less than 5% of the revenue districts in the country. About 90,000 MW of such new capacity is planned within the same districts of critically polluted areas as identified by MoEF. Such high concentration of coal power plants in small geographical areas can only worsen the pollution problem for these areas, with disastrous consequences to the locals.

Since coal power plants need huge amounts of fresh water, the proposed plants, which are to be located inlands, will create new dimension to the fresh water availability to people and agriculture. The geographical concentration of many coal power plants in a small area will aggravate this situation, and it will be difficult to provide water to these plants during lean months of the year. Most of the fresh water resources in such areas are already stressed, and people's legitimate demand for even domestic consumption is being increasingly threatened even before such plants are planned. The report has estimated that those power plants which already have Environmental Clearance from MoEF may demand about 4.6 billion cubic meters of fresh water per year. Even if 50% of the proposed 700,000 MW power plants are to get to fruition the number of potential water conflict can be great.

The report has also estimated that this much of water can provide irrigation to more than 900,000 hectares of land each year. The gravity of the situation becomes clear when we also realise that 4.6 billion cubic meters per year can meet the drinking water needs of about 7% of the population in India at present.

The cumulative impacts of many coal power plants in a small geographical area on social and environmental aspects of our poor communities have never been studied from the community perspective. Such cumulative impacts can be much graver in comparison to a single project. One such study has been done by

Cerana Foundation, Hyderabad in August 2011. This study report indicates that a total of 24 coal power projects (totaling about 27,000 MW capacity), with 8 projects of total capacity 14,300 MW, already having been given environmental clearance, are planned to be located near Krishnapatnam, a port city in South Andhra Pradesh. The report notes that the combined impact of the proposed plants on the environment, human health and livelihoods has not been assessed either by the project proponents or the regulatory authorities. These plants will store the following hazardous substances—chlorine, hydrogen, light diesel oil. A brief review was made of the EIAs of the 8 projects.

The highlights of the study by Cerana Foundation on a cluster of coal power plants at Krishnapatnam, Andhra Pradesh:
The Indian AAQ 24-hour standards will be exceeded in 13 villages; Power stations would cause approximately 500 excess deaths per annum in a 50 km radius. The number of excess deaths for all the proposed 24 plants would be approximately 1,200 deaths/year. Toxic and radioactive heavy metals in ash and coal and nano-particles will increase health risk in the vicinity of the power plants and the port.
Other significant impacts predicted are: Agriculture losses; forest diebacks; corrosion of water bodies and impact on aquatic ecology; corrosion of monuments; ecology of water bodies; heavy metals from ash ponds leaching into groundwater; industrialization and social conflict. The report has concluded that the regulatory authorities have failed to apply due diligence, and the environmental clearance procedures are fatally flawed. Cumulative impact assessment of all the proposed plants is considered essential.

A report by Brettonwoods Project under the title: "No fairy tale: Singrauli, India, still suffering years after World Bank coal investments", has studied the socio-environmental impacts of a large number of coal mining/power projects in a small geographical area. It has indicated how World Bank's funding for developing coalmines/power projects in the coal belt of Singrauli district in Madhya Pradesh and Sonbhadra district in Uttar Pradesh, instead of turning the region into a development fairy tale, has set the stage for new and devastating coal projects that are contributing to further environmental degradation, displacement of communities from their land, and undermining of local livelihoods. This area was once a densely forested region, but is now a conglomeration of 11 open coal mines, and seven coal-fired power plants, with proposals to expand this to 17 more, all in an area of 1,800 square kilometres. The coal ash, known to have carcinogenic properties, from the operating coal power plants are being sent in huge quantities to massive open ponds. This has resulted in incalculable damages to the landscape, environment and livelihoods, particularly of the local tribal people reliant on the forests. "They have taken a huge forest area that Nehru called

the Switzerland of India, and destroyed it. How will this irreparable loss be compensated? This is a major lasting impact of the World Bank's funding, along with others. It is not very easy for the World Bank to wash their hands of this," one of the activists who has studied the local problems has said.

The popular opposition to large size coal power projects are growing to such an extent that many project proposals are being cancelled. Two such recent examples are the Ultra Mega Power Projects (UMPP) near Tadadi, in Karnataka, and Girye in Maharastra which were cancelled due to popular opposition. In recent years due to active involvement of NGOs in protecting the rights of the locals and of bio-diversity, the opposition to large size coal power projects has become a common factor because of the issues such as adequate compensation, threat to livelihood, cultivable land, fresh water, agricultural crop loss, and health problems are being adequately highlighted. Many of such oppositions are being taken to the court of law, where the judiciary is taking serious note of social injustice and environmental degradation. Whereas IEP has just mentioned that some of these issues have to be sorted out, no discussions have been done to recommend credible remedies.

> Few major issues of concern to our thickly populated society, which cannot be ignored at all, are: the issues of forcible land acquisition, diversion of scarce fresh water for coal power plants, impact on agricultural production, and health issues associated with coal burning. IEP has not even adequately referred to these issues, whereas it claims to address the issue of energy security in order to ensure poverty eradication and human development goals.

It is evident that for the densely populated communities in our country these issues have much higher priority than the vague assurance of electricity supply, which, anyway, has never been kept in the past.

It is a very distressing feeling even to imagine how large concentration of coal mines/power plants elsewhere, in AP coast, Orissa coast, coal fields of MP, Vidarbha, Konkan Maharastra and Chattisgarh may devastate the lives of the people. Unmindful of such consequences MoEF is known to be awarding environmental clearance to tens of coal power plants every year.

3.6 Environmental and health issues – global warming implications

The environmental and health aspects of a coal based power policy are enormous for a country such as India with densely populated communities and limited natural resources. As per a report from Down To Earth magazine; Dec. 12, 2008, (Annexure 5) Indian coal power plants demand large tracts of land (about 0.4 hectare per

MW of capacity) and huge quantities of fresh water (about 80 Cubic meters per 1,000 KWH of energy production while the global best practice is just 10 cubic m/1,000 KWH). They burn enormous quantity of coal (about 0.7 kg per kWH) and generate mountains of ash (about 40 % of ash content in Indian coal). As per this report from Down To Earth magazine, in 2005-06 the state owned coal power stations were estimated to have generated about 113 million tons of fly ash, 1 million tons of particulate matter, 347 million tons of CO_2, 19 million tons of Sulphur di-oxide and tons of mercury and Nitric Oxides & other flue gases. Such a high level of pollution invariably leads to serious health problems; affects agricultural production; impacts fresh water sources and flora& fauna; and threatens the livelihood for the local communities. These and the other indirect costs on account of healthcare and lost productivity are generally not taken note of due to vividness bias. Despite many recommendations in the recent past to minimise these pollutants the overall impact of these pollutants on our society has only increased because of the increase in total number of coal power plants. But IEP has chosen to be silent on these issues of both local and global importance.

A scientific report "Radioelemental characterization of fly ash from Chandrapur Super Thermal Power Station, Maharashtra, India" by Rajeev Menon, P. Raja, Deepak Malpe, K. S. V. Subramaniyam and V. Balaram {Current Science (Volume 100, No.12, 25 June 2011} has thrown up very disturbing facts.

It says "Natural radioactivity due to the presence of 40K, 238U and 232Th was measured in fly ash samples collected from economizer, aerator and electrostatic precipitator (EP) of the Chandrapur Super Thermal Power Station (CSTPS). The study indicates an elevated concentration of these radionuclides, especially in the finer ash samples from EP, which may provide an exposure pathway through inhalation of airborne ashes and could probably cause severe environmental and human health problems. The present study gains significance as it provides the requisite basic data on the radionuclides concentration in fly ash from CSTPS for a detailed follow up of environmental monitoring and to formulate effective management strategies. "

"Accumulation of 238U, 232Th and 40K in the fly ash deposits in the vicinity of a thermal power plant over a considerable period of time may pose significant ecological burden through atmospheric pollution. Direct addition of radionuclides to surface waters and their subsequent leaching into the soil system will ultimately reach humans through the drinking water–crop pathways. Therefore, caution should be exercised in dumping the fly ash and essential preemptive steps should be taken prior to the alarming increase in concentration of radionuclides in fly ash, which will have irrevocable and disastrous effects on the fragile ecology and environment. In addition, the potential threat of these radionuclides in the long run should not be ignored and regular environmental monitoring is required to put a check on the increasing level of pollution in and around CSTPS."

Ignoring these far reaching consequences IEP says: “A massive effort is clearly required to expand domestic coal production”. Even though the high ash content and the low calorific value of domestic coal have been mentioned in the report, the projection still recommends massive increase in coal mining and coal power capacity. If the coal power capacity were to increase 5 times by 2031-32 as per IEP projections, it is realistic to assume that the pollutants and other concerns (as listed in the table 7) also will increase by about 4.5 times, even if we allow for efficiency improvements in pollution reduction measures. The health and environmental impacts of such a large increase in coal power capacity will be colossal. Not dealing with such critical issues may be termed as a major deficiency in IEP report.

Even ecologically sensitive places such as river estuaries, sensitive coastal areas, and vicinity of bio-diversity hotspots such as Western Ghats are being proposed to locate such high polluting power plants. Examples of such callous decisions are the UMPPs proposed near Tadadi, in Karnataka, and Girye in Maharastra, both on coasts, near estuaries and in the close vicinity of Western Ghats. In a statement which may indicate the gross neglect of the social and environmental aspects of large coal power plants on coastal regions IEP makes a statement: “Unfortunately coal consumption at coastal sites is currently minimal”. As though taking a cue from this statement a large number of power plants is being proposed /built all over the east and west coasts of the country. A large number of coal power plants are already in various stages of planning/ implementation/ operation in such sensitive areas (in the states of Orissa, Andhra Pradesh, Tamil Nadu, Maharastra and Gujarath) of east and west coasts. Such irrational decisions are resulting in great burden to the society in the form of unacceptable magnitude of social and environmental costs. Naturally, a huge groundswell of opposition to these projects is being reported.

IEP does not appear to have devoted any time to deliberate on such crucial issues. Without satisfactorily addressing these issues it is not clear how public’s support can be expected for this policy. An obvious result of such a coal based power policy for the country is that the states seem to be in a great hurry to build large number of coal power plants either in State sector or private sector without objectively considering the long term impacts of such additions, or diligently following the commonly known norms. The liberalisation regime consequent to IE Act 2003 [3.3], needing no license but only few clearances, such as environmental clearance to build a coal power plant, has become a catalyst for large number of coal power plants mushrooming all over the country.

While planning for future power generating capacity expansion all these issues must be taken into objective account. It should ne

> As per a notification of the Ministry of Coal in February 2009, 63 applications from State Electricity Boards, 234 applications from independent power producers (IPP), 180 applications from Captive Power Plants were pending as on 2nd February 2009 for coal linkages for power plants of various sizes. These are huge numbers, and will escalate in the years to come unless urgent course corrections are applied. Our society's proven inability in identifying and implementing the strict norms for pollution control, and wanton incompetency in enforcing even the modest conditions of license has meant that the deleterious impacts of such a large number of polluting power plants has the potential to devastate our way of life.

noted that none of the past 5 year plans, including the present one, have achieved the original target capacity addition. The reason for such a tardy progress is the lack of due diligence and absence of effective public consultations, which might have lead to delays due to litigation in courts of law.

A less known report from USA states that the coal-fired power plants throughout the world are the major sources of radioactive materials released to the environment, and that there are several serious implications of such radioactive emissions. This report with the title "Coal Combustion: Nuclear Resource or Danger" by Alex Gabbard suggests that coal combustion is more hazardous to health than nuclear power, and that it adds to the background radiation burden even more than that by nuclear power[3.4]. It also suggests that if radiation emissions from coal plants were regulated, their capital and operating costs would increase, making coal-fired power less economically competitive. The authors of the report concluded that Americans living near coal-fired power plants are exposed to higher radiation doses than those living near nuclear power plants that meet government regulations. A similar scenario in Indian conditions and serious ramifications of it are not inconceivable. While the society needs to ensure adequate safety precautions in this regard, it is very unfortunate that IEP has not even mentioned the possibility of background radiation burden from coal burning in the country.

Another authentic report on the major health effects of massive coal burning is a report of 2009 by the title "Coal's Assault on Human Health" by Physicians for Social Responsibility. This report refers to coal combustion emissions such as sulfur dioxide, particulate matter (PM), nitric oxides, mercury, and a number of other hazardous substances, which damage the respiratory, cardiovascular and nervous systems of the human body. In particular, these emissions contribute to some of the most widespread diseases, including asthma, heart disease, stroke, and lung cancer (Annexure 6).

In December 2011, the U.S. Environmental Protection Agency

rolled out landmark nationwide protections for toxic mercury from coal power plants. Mercury is known to be a dangerous brain poison that taints the fish people eat and poses a particular threat to prenatal babies and young children. Exposure in the bloodstreams of pregnant and nursing women can result in birth defects such as learning disabilities, lowered IQ, deafness, blindness and cerebral palsy. Coal-fired power plants are considered to be the largest source of mercury pollution in the United States, pumping more than 33 tons of this dangerous toxin into the air and water each year. The new protection, which replaces a weak, court-rejected standard from the Bush Administration, is expected to slash mercury pollution from power plants by more than 90 percent and improve air quality for millions of Americans.

A report from The New York Times of 6 January, 2009 seem to summarise the overall concerns on coal power industry.

"The coal ash pond that ruptured and sent a billion gallons of toxic sludge across 300 acres of East Tennessee last month was only one of more than 1,300 similar dumps across the United States — most of them unregulated and unmonitored — that contain billions more gallons of fly ash and other byproducts of burning coal.

Like the one in Tennessee, most of these dumps, which reach up to 1,500 acres, contain heavy metals like arsenic, lead, mercury and selenium, which are considered by the Environmental Protection Agency to be a threat to water supplies and human health. Yet they are not subject to any federal regulation, which experts say could have prevented the spill, and there is little monitoring of their effects on the surrounding environment. Numerous studies have shown that the ash can leach toxic substances that can cause cancer, birth defects and other health problems in humans, and can decimate fish, bird and frog populations in and around ash dumps, causing developmental problems like tadpoles born without teeth, or fish with severe spinal deformities. "Your household garbage is managed much more consistently" than coal combustion waste, said Dr. Thomas A. Burke, an epidemiologist at the Johns Hopkins Bloomberg School of Public Health, who testified on the health effects of coal ash before a Congressional subcommittee last year. "It's such a large volume of waste, and it's so essential to the country's energy supply; it's basically been a loophole in the country's waste management strategy."

As the E.P.A. has studied whether to regulate coal ash waste, the cases of drinking wells and surface water contaminated by leaching from the dumps or the use of the ash has swelled. In 2007, an E.P.A. report identified 63 sites in 26 states where the water was contaminated by heavy metals from such dumps, including three other Tennessee Valley Authority dumps. Environmental advocacy groups have submitted at least 17 additional cases that they say should be added to that list.

Just last week, a judge approved a $54 million class-action settlement against Constellation Power Generation after it had dumped coal ash for more than a decade in a sand and gravel pit near Gambrills, Md., about

> 20 miles south of Baltimore, contaminating wells. And Town of Pines, Ind., a hamlet about 40 miles east of Chicago, was declared a Superfund site after wells there were found to be contaminated by ash dumped in a landfill and used to make roads starting in 1983.
> Contamination can be swift. In Chesapeake, Va., high levels of lead, arsenic and other contaminants were found last year in the groundwater beneath a golf course sculptured with 1.5 million tons of fly ash, the same type of coal ash involved in the Tennessee spill. The golf course opened in 2007."

If a large country like USA with much large land area and resources, but with much less population is so much concerned about the health effects of coal burning, the much more constrained society like ours must thoroughly review the pros & cons and the true relevance of the large number of coal mines and coal power plants being proposed in the country.

Recently Greenpeace had commissioned the Institute for Environmental Health and Related Product Safety under the Chinese Centre for Disease Control and Prevention to produce a report, The True Cost of Coal – Air Pollution and Public Health (2011). Coal combustion is China's main source of air pollution. It is the source of 70% of the country's soot emissions; 85% of its sulfur dioxide emissions; 67% of its nitrogen oxide emissions; and 80% of its carbon dioxide emissions. The coal-fired power sector makes up more than 50% of national coal consumption. It is the single largest emitter of air pollutants. It has listed many health problems associated with coal mining and combustion (Annexure-7).

An irony of the global policy in containing the global warming impacts has been the decision of the United Nations Framework Convention on Climate Change (UNFCCC) to award Clean Development Mechanism (CDM) benefits to coal power plants based on super critical technology. Four coal power plants in India are known to have applied for such CDM registration in recent months on the premise that the super critical technology to be deployed in such projects would lead to reduced CO_2 emission, and hence qualify for financial benefits under CDM. The present scenario calls for a serious examination of such a claim because a detailed examination of nominated coal power projects will reveal that such projects will result in net increase in CO_2 emissions at the country level, and hence defeat the very purpose of CDM.

Super critical coal power plants will only reduce the emissions marginally. Such coal power plants are expected to involve an increase in thermal efficiency from about 33 - 35% for sub-critical coal power plants to about 37-39%, and may corresponds to a reduction of about 4 to 5% in emissions. But such super critical coal power plants will continue to consume a lot of coal, and water;

they lead to destruction of thick tropical forests below which are the coal reserve; and they pollute the air, land and fresh water sources. Hence while the GHG potential of such individual coal power plants can be marginally less as compared to sub-critical coal power plants, the overall increase in GHGs at the country level will be much higher because of the addition of large number of such power plants. This defeats the very purpose of UNFCCC and CDM. Most environmental groups have called for an end to crediting coal plants with fighting global warming, and the CDM was reported to be reconsidering this issue as at the end of 2011.

3.7 International experiences on environment and health cost of coal power

The coal power lobbies in India resort to frequent comparison in coal power capacity with China, which is known to have added a lot of coal power capacity during a short span of 10 -15 years from 1995 onwards. International reports indicate that in China on an average one coal based power unit was commissioned every 15 days from Year 2000 onwards. A comparison of the environmental disaster that is facing China because of its coal power policy is worth noticing. With so much of coal power having been added in such a short period there was no escaping the colossal pollution because the carrying capacity of the nature there seems to have reached a tipping point.

No surprise, hence, that China is considered the second biggest polluter in the world. The atmospheric pollution there seem to be so heavy that a survey few years ago has revealed that about 50% of the rivers covered in the survey were found to be unfit for drinking. So much so that when Beijing won the rights to host 2008 Olympics it had to undertake massive clean up operation in and around Beijing to make the air acceptable for breathing easily. As a part of this clean up drive on an average one old coal power unit was reported to have been decommissioned every month for few years.

According to World Bank estimates China is also fast becoming an ecological wasteland, home to world-class smog, acid rain, polluted rivers and lakes, and deforestation. Environmental problems are reported to play a major role in the death of some 300,000 Chinese people each year. The massive impacts of such huge additions in a short while on Chinese society are described by a Business Week report ('Coal Secrets of China') in August 2005 (as in Annexure 8).

Reuters in a news report on 16 Feb. 2011 ("Coal's hidden costs top $345 billion in U.S. - study") says that "the United States' reliance on coal to generate almost half of its electricity, costs the economy about $345 billion a year in hidden expenses not borne by miners or utilities, including health problems in mining communities and pollution around power plants, a study found".

"The assessment of health impact caused by energy use in urban areas of China: an intake fraction–based Analysis": Beijing Institute of Technology and Chinese Academy of Sciences; 22 January 2011
"The coal-dominated fossil fuel has sustained China's rapid development in the last 30 years. However, the massive coal combustion also contributed to a heavy burden of illness and health damage through pollution of local and regional environments (Wilkinson et al. 2007). Because of the unsustainable development pattern, accompanying with the economic development, the dramatically deteriorated environment has made China the air pollution capital of the world (Watts 2005). Currently, China is the largest source of SO_2 emissions in the world (World Bank 2007). The fast growing energy consumption may increase SO_2 and other pollutant emissions. A lot of epidemiological studies show coherent associations between air pollution and many diseases like respiratory symptoms, reduced lung function, chronic bronchitis, and mortality (World Bank 2007). World Bank (2007) estimated the economic implications of environmental degradation by estimating the cost of air and water pollution in China. According to the assessment, the pollution cost was between 3.5% and 8% of China's GDP of 2003.."
The results of this report are revealing: (i) air pollution from industrial fossil-fuel combustion caused 370,000 deaths in 2007; (ii) based on this data it is estimated that 190,000 out of these were caused by pollution from coal-fired power plants; (iii) other impacts include a million hospital admissions, two million respiratory infections and 5 million cases of bronchitis, 200 million asthma attacks and almost 5 billion days of restricted activity: (iv) industrial air pollution cost the economy 3% of GDP, 43% of which was due to pollution from coal-fired power plants - total damage from coal plants was 250 billion Yuan.

"Beyond Coal" is a campaign launched by Sierra Club, USA to disseminate all the relevant information on coal industry. It is known to have focused on the socio-environmental aspects of coal industry in USA for many decades. In alliance with like minded NGOs in other parts of the world it is helping to minimise the deleterious impacts of coal industry on the affected communities.

Greenpeace India (GPI) has been trying hard, for a number of years, to draw the attention of the people on the environmental and health impacts of coal power. In various reports such as "True cost of coal", "Still Waiting" "Hiding Behind the Poor" and few reports of fact finding missions to coal mining/coal power plant areas, GPI has described in gory details the social and environmental impacts of coal mining/burning, and ash dumping activities. These reports also have revealed that though the coal power plants are loading a lot of direct and indirect costs on to the society, they are not really addressing even the life-line electricity requirements of the poor and vulnerable sections of our society. Energy injustice continues despite massive costs to our communities due to additions to coal power capacity ever since

independence.

Two articles "Environmental Accounting for Pollution in the United States Economy" (by Nicholas Z. Muller, Robert Mendelsohn, and William Nordhaus in American Economic Review) and Life-cycle study: (by Dr. Paul Epstein, in Annals of the New York Academy of Sciences) have studied in detail the external costs of coal power. The cost to the US society associated with pollution, health and Climate Change were analysed in these two studies. Two conclusions from these studies have huge significance. The first is that while these assessments involve significant uncertainties, they agree that the true cost of coal, after taking into account the externalities, is not accurately reflected in its market price. The analysis suggests that the true cost lies somewhere between ~50% and 300% more than Americans are currently paying. The first study on detailed analysis of the damages due to coal power, have estimated that SO2 emissions are responsible for 87% of the damages associated with coal power emissions (excluding climate change), and 94% of the damages come in the form of increased mortality. For those who claim that burning coal is safe and harmless, the numbers tell a very different story, even without including the effects associated with climate change.

In the Indian context, where emission controls are known to be less stringent, and where population density is much higher such external costs are likely to be many times more than that in US.

3.8 Impacts on agriculture and fisheries

With a large number of coal power plants being proposed all over the country, the proximity of such power plants to rich agricultural lands and fishing areas is increasingly becoming a matter of great concerns to poorer sections of our society.

A study report by the title "ANALYSIS OF EXTERNALITIES DUE TO FLY ASH FROM RTPS ON AGRICULTURE - AN ENVIRONMENTAL ECONOMIC STUDY" by a Junior Research Fellow, of the Department of Agricultural Economics, UAS, Bangalore has revealed many issues of concern to our society. In this study of agricultural fields around Raichur Thermal Power Station (RTPS) consisting of 7 units (at that time) with a generating capacity of 210 MW each, in the state of Karnataka were surveyed. It says "The fly ash released during burning process of coal in thermal power plants disperses in air, which enters into the surrounding environment and known to pollute the surrounding area". The report opines that the fly ash thus entered the environment deposits on leaves of trees, crop plants affecting the physiological process of the plants resulting in poor yield of the crop plants which in turn results in low returns to the farmers.

It concludes that the farmers are incurring huge losses in agriculture and on health grounds due to the pollution from fly ash. Farmers with the expectation of getting yield on par with the control area were using higher quantities of inputs. However, the farmers in the affected area were unable to realise the

yield levels of the control area. The productivity of paddy, Sorghum and cotton (which were studied in detail), as compared to that in control areas (50 kM away), were found to be least (30 % to 50%) in the agricultural plots nearest to the power plant (within 3 kM). Also higher cost was incurred by farmers in the affected area as compared to the control zone. The net returns realised for paddy, cotton, chilli and sorghum in the affected areas were lower as compared to that in control areas.

The fly ash from the chimneys of the power plant, hot water discharge from the cooling systems, coal dust from the coal yard, and other associated pollutants are known to have impacted the sea water and the fish yield in coastal zone in the coal power plants. The dry ash, which are generally held in the ash ponds, are also known to have been washed away to the nearby rivers/stream during the times of flooding, and are known to have affected the fish population in fresh water also.

The impact on the fish catch is a major concern for the fishermen on the coast. In some cases the fishermen are also denied access to the fishing areas on the sea adjacent to coal power plants. All these factors have forced the fishermen to oppose the coal power plants in the coastal areas.

In view of the fact that coal power plants contribute substantial portion of Green House Gas (GHG) emissions, the international scientific community such as Inter Governmental Panel on Climate Change (IPCC) are unanimous that the emissions from coal power plants have to be minimised at the earliest, which means minimising the number of coal power plants instead of increasing them. In this regard the additional coal power capacity in MoEF pipeline of about 700,000 MW, as reported in the media, should be viewed as a grave threat to the welfare of our communities, and hence should be objectively reviewed.

Reference material

3.1: "Carbon capture and storage":
http://en.wikipedia.org/wiki/Carbon_capture_and_storage

3.2: "Clean Development Mechanism (CDM) & UNFCCC"
http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

3.3: IE Act 2003;
http://www.powermin.nic.in/acts_notification/electricity_act2003/preliminary.htm

3.4: "Radiological Impact of Airborne Effluents of Coal and Nuclear Plants"; Former ORNL researchers J. P. McBride, R. E. Moore, J. P. Witherspoon, and R. E. Blanco; December 8, 1978, issue of Science magazine.

Some of the other reports/ websites, which have focused on impacts of coal power plants, are:

(i) "Coal Ash: the toxic threat to our health and environment" by Physicians for Social Responsibility and Earth Justice;
(ii) "Benefits of Beyond BAU : Human, Social, and Environmental Damages Avoided through the Retirement of the US Coal Fleet" prepared for Civil Society Institute; USA
(iii) "The mining and burning of coal: effects on health and the environment", Medical Journal Australia; MJA 195 (6) • 19 September 2011
(iv) "Thermal power Plants on the Anvil: implications and the need for rationalization" by Prayas Energy Group, Pune;
(v) "The True Cost of Coal – Air Pollution and Public Health" in China by Greenpeace; www.greenpeaceindia.org
(vi) "COMBINED ENVIRONMENTAL IMPACT OF COAL-BASED THERMAL POWER PLANTS AT KRISHNAPATNAM": Cerana Foundation, Hyderabad,; August 2011
(vii) "Global warming, CDM and coal power plants": http://www.indiaenvironmentportal.org.in/reports-documents/global-warming-cdm-and-coal-power-plants
(viii) Website of Sierra Club, USA: http://www.sierraclub.org/
(ix) "Beyond Coal" Campaign: http://clubhouse.sierraclub.org/conservation/energy/coal/coal-resources.aspx#Coal_Reports:_General_&_State-Specific
(x) http://www.cea.nic.in/wing_report.html
(xi) NTPC : http://www.ntpc.co.in/
(xii) " No public, just hearings for mega projects", http://www.thehindu.com/news/states/other-states/article2803877.ece
(xiii) "The assessment of health impact caused by energy use in urban areas of China: an intake fraction–based Analysis": Beijing Institute of Technology and Chinese Academy of Sciences; 10Aug. 2011
(xiv) "Environmental Accounting for Pollution in the United States Economy" (by Nicholas Z. Muller, Robert Mendelsohn, and William Nordhaus in American Economic Review, 2011) ; http://thinkprogress.org/romm/2011/10/13/332882/economics-coal-fired-power-plants-air-pollution-damages/
(xv) " Life-cycle study:" (by Dr. Paul Epstein, in Annals of the New York Academy of Sciences, 2011): http://thinkprogress.org/romm/2011/02/16/207534/life-cycle-study-coal-harvard-epstein-health/
(xvi) " Global warming, CDM and coal power plants": http://www.indiaenvironmentportal.org.in/reports-documents/global-warming-cdm-and-coal-power-plants
(xvii) The Carbon Capture and Sequestration Technologies Program at MIT: http://sequestration.mit.edu/index.html
(xviii) "Scientific Facts on CO_2 Capture and Storage": http://www.greenfacts.org/en/co2-capture-storage/index.htm

Chapter 4

Large hydro power capacity addition:
is it really green and renewable?

Key terms: load factor; submersion of lands; fragmentation of forests; river ecology; aquatic creatures, methane emission, environment flow, resettlement of Project Affected Families, EIA

Chapter Summary

On objective consideration of social, economic, environmental, and intergenerational issues, it becomes evident that the recommendation by IEP to increase the hydel capacity in the country from the present level of about 37,000 MW to 150,000 MW by 2031-32 need a thorough review considering all the costs and benefits to the nation, and the long term welfare of our communities. The critical importance of a free flowing river to the bio-diversity and the communities, which are dependent on it, cannot be ignored at any cost. Country's own experience in building and operating the dams, international experiences, and the legitimate concerns of its communities should be kept in mind. To enable this approach various stake holders must be effectively involved in the relevant decision making processes.

IEP envisages large role for hydel (hydro-electrical) power as far as installed capacity is concerned. It identifies a total hydel power capacity of 84,000 MW at 60% load factor in the country, but projects that planning should be done for 150,000 MW capacity at a much lower load factor of about 30% by the year 2031-32. This massive increase in hydel capacity of about 4 times (from the capacity of about 37,000 MW in 2006) in 25 years will pose huge socio-environmental problems, which unfortunately have not been discussed in any detail.

If we consider the fact that it has taken more than 100 years to commission about 37,000 MW of hydel power in the country, it would be very hard to imagine how the capacity can be increased to 150,000 MW in the next 25 years. The issues such as submersion of fertile agricultural and/ or thick forest lands in the dam waters, displacement & resettlement of project affected families, massive impact on river ecology and aquatic creatures, methane emission, socio-economic issues associated with reduced flow in the river etc.

are all so complex and acute that almost every hydel project is being sternly opposed by the local communities and environmentalists.

Neither the report of the World Commission on Dams ("Dams and Development: A New Framework for Decision-Making")[4.1], nor the report by International Commission on Large Dams (ICOLD)[4.2] has been in blind support of large dams. Both of these reports have strongly advised extreme caution and thorough consultations with all the stake holders before taking decision to build dams. Our own past history of not demonstrating adequate responsibility in correct planning, execution, monitoring, rehabilitation, reporting etc. has resulted in strong resentment against future dams. The judicial system has also been taking a keen interest in upholding the constitutional rights behind such popular opposition to any hydel project which would further reduce our forest cover and displace communities.

Where as the Narmada Valley hydel projects are going ahead despite massive opposition, many other projects such as Silent Valley project in Kerala, Bedthi project in Karnataka, few recent projects in Uttarakhand and Sikkim have been cancelled due to massive opposition by the locals. Proposals for Gundia hydel project in Karnataka and Athirapally hydel project in Kerala are likely to be denied the environmental clearance because of massive opposition to these projects on social and environmental grounds; and also on the recommendations of Western Ghats Expert Ecology Panel (WGEEP). Many other hydel project proposals in Uttarakhand, Sikkim, Manipur and Arunachal Pradesh are being opposed strongly on various grounds, mostly on socio-environmental grounds. The past and present oppositions to hydel projects have not been considered in IEP while proposing a large addition to hydel capacity.

IEP's projection of 150,000 MW hydel capacity at a low load factor of about 30% by the year 2031-32 throws up many issues. 30% load factor basically means that on an average the power station capacity is designed to be used only for 30% of the time. While horrendous amounts of resources including land, buildings, machinery, transmission lines, hydraulic structures, roads etc. will be used up to build such a large capacity at huge costs to the society, the electricity is expected to be generated for a small period in a year with the assets expected to be idle for 70% of the time. This is in stark comparison to 50-60% load factor generally associated with a large dam based hydel power project. But there are serious issues of optimal usage of our resources even in the case of existing hydel power plants designed for higher load factors.

The dam building activity has been known to transform the landscape, ecology and economy of the region, and also to have far

reaching consequences all the way to the river deltas such as Sunder Bans in case of river Ganga.

Table 10: Major issues for the society with hydel power projects

Economic Issues	Demands large tracts of forest and fertile agricultural land; water logging affects the economy of down stream population; denial of silt affects the agriculture downstream; threat of localized earthquake due to impoundment of water; local economy may suffer due to isolation because of land submersion.
Social Issues	Peoples' displacement and Health; isolation of affected communities; compensation issues will create social tensions and stiff opposition; local buildings of heritage importance may get submerged; nearby places of tourist and religious importance may get drowned; may cause serious erosion of local communities; livelihood issues; gradual death of local villages; safety of dams in Himalayas due to glacial lake outburst is a serious issue to contend with.
Environmental Issues	Submersion and fragmentation of forests; loss of bio-diversity; Methane emission; downstream areas get deprived of fertile silt; local pollution due to construction materials; erosion of river banks due to water level variation; threat to aquatic creatures in downstream; sea erosion due to reduced pressure of the river at the delta.

4.1 Economic and technical issues

Some of the major economic issues associated closely with dam based hydel projects, which the IEP seem to have ignored to factor in are:

- Submergence of lands, agricultural fields, forests, grazing lands and homes on a large scale can lead to the displacement of a large number of people. This in turn can threaten the very livelihoods for the Project Affected Families (PAFs).
- The compensation that may be admissible to such people is generally considered to be inadequate to enable them to lead a satisfactory life, as has been the recent past experiences. In any project there will be a substantial percentage of local population, who may not have legal rights to the land, but are heavily dependent on the local natural resources such as land, river and forests. Our society's inability, as has been recorded in the past, to undertake and ensure comprehensive rehabilitation of such PAFs has turned out to be a major economic disaster because many of PAFs who were leading a satisfactory life in a traditional system, have become destitute after displacement; some of them have been

subjected to multiple displacements.

- Disruption to downstream flows will have impact on agriculture and fisheries threatening the livelihoods of people, who have no other employment skills to depend on.
- Sedimentation has been a major issue with Himalayan dams. Reports indicate that the sedimentation rates are the highest in Himalayan rivers amongst all the Indian rivers. A dam designed for a life of 50 + years may become fully silted in about 30 years if adequate measures are not taken to: (i) reduce silts from the slopes of river valleys, and (ii) allow the majority of silt to pass through the dams.
- Another major issue with dams is that the quantity, quality and pattern of water flow in the rivers get heavily impacted with the result that biodiversity dependent on river flow is severely affected. At the global scale the value of ecological functions as well as resources of the environment (both terrestrial and aquatic) has been estimated to be about $33 trillion per year, which is almost twice the global domestic product. Fresh water ecosystems are considered to be ecologically more valuable than the terrestrial ones. Even if we consider that this value is equal to the GDP of our country, the losses to the society by building so many hydro power dams will be immense. In this context IEP has completely ignored even the economic implications of loosing the wealth of the bio-diversity lost/impacted by hydel projects.
- Construction of dams are preceded by clearing of trees, excavation, fragmentation of the forests, dumping of debris/ construction materials, noise and air pollution due to construction activities etc. These would lead to the degradation of natural surroundings, and to degraded water sources.
- Impounding of water in the dams is known to cut off access roads thus isolating villages/ communities. This has adverse effect on the economy of the locals.
- The cumulative impact of a number of dams in one region, or as a cascade of dams on one river is much higher as compared to the impact of a single dam.
- Himalayan region has been known to be seismically very sensitive, and hence dams in this region face potential risk of catastrophic failures from earthquakes.
- Another area of concern for building dams in Himalayas is the threat due to Global Warming. With the accelerated glacial melting the dams are likely to see huge increase in inflows initially and then highly reduced inflows in subsequent decades. This effect is likely to threaten the safety and economy of the dams.
- Additionally, the floods caused by Glacial Lake Outbursts, which are fairly common to Himalayan region can threaten the safety of dams.

- The vastly reduced amounts of silts in rivers obstructed by dams would have serious impact on the nature and area of river deltas. They are known to have resulted in ingress of sea inlands affecting the water quality. There are reports that in Gangetic delta such erosions have resulted in considerable reduction in the size of delta, and hence there can be an issue of territorial integrity.

> In respect of Run Of River schemes with pondage, frequent shutdown of the plant is required in hydro season to flush out the silt from the small reservoir. Such outages lead to loss of generation which is generally not factored in the techno economic analysis.
> Similarly, release of a minimum quantity of water through spillway gates to ensure that the flora and fauna along the original river course is unaffected and people along the river shore are able to perform their daily chores without hindrance, is generally not factored in techno economic feasibility reports.
> Likewise hydro power has other political uncertainties also. Government of J & K was reported to have announced water usage charges of 25 paise/cubic metre of water used by hydro power projects. Such charges would change the feasibility of hydro projects drastically.

Some of the arguments offered by IEP to project 150,000 MW of hydel power by 2031-32 are:

- that hydel power is renewable and green power,
- that it will provide the much needed peak hour demand support,
- that it will provide the much needed water security through storage facility.

Because of the emission of Methane as a more potent GHG (21 times of CO_2) and drowning of large tracts of forest lands hydel power cannot be considered green in its real sense. Since the dam, power plant and the associated structures have to be abandoned/decommissioned after the useful life of about 50 years it cannot be termed as renewable either.

Though the flexibility of starting and stopping hydel power quickly is beneficial from the operational perspective of the electricity network, in view of the huge impacts on the society of such projects it becomes essential to analyse whether such a facility is essential. There are many power systems, much larger than that of Indian power system with predominantly non-hydro power, which are functioning satisfactorily for decades. Examples are the power systems in France, Japan and UK. As long as we can keep the gap between peak hour demand and average demand in a day within the limits of the total thermal power capacity of the system there is really no need to have a large hydel power base as suggested by

IEP. And there are viable means of reducing the peak hour demand. Gas based power plants also can provide the peak hour support, if really needed.

IEP advocates more of large size dam based hydel projects on the premise that such dams will assist in water security also. For some strange reasons IEP has ignored the huge potential associated with rain water harvesting not only to provide much higher water security but also to reduce the demand for electricity in water pumping needs.

The concept of large dams for the sake of water security is being strongly questioned in different parts of the world. The official project reports [detailed project report (DPR)] of hydro power projects are known to ignore the true cost of decommissioning of dams, once their economic life comes to an end. These costs when taken into objective account can have a major impact on the cost V/S benefit ratio of the project itself. In a recent book "Economics of River Flows" Dr. Bharat Jhunjhunwala has addressed the topic in the background of such experiences in USA. He has shown that the economics of dam building are being seriously analysed on credible grounds in USA, because of which many dams are being decommissioned, and which should forewarn our society of the costly experiments we may be undertaking in building a large number of dams. There are also credible arguments that dams can be source of floods instead of the traditional view of flood controllers.

Himanshu Thakkar of the 'South Asia Network on Dams, Rivers and People' says there are around 500 dams in India which are between 50 and 100 years old. He says: "In all as many as 604 dams has lived the life of 50 years and above. But the country is yet to have a clearly defined, legally binding accountability mechanism in case of dam failures or unsafe dam operations and for determining what is to be done with old dams that become a threat to lives, livelihood and environment." It is also reported that there are at least 100 large dams in the country which are over one hundred years old and which calls for urgent steps and legal mechanism to ensure the safety of people and the structures. The recent controversy (January 2012) over Mullaperiyar Dam located in Kerala but beneficial to Tamil Nadu is a case to consider in this regard because it is more than 115 years old.

A news article on dam removals in US under the title "The tide turns on nation's dams" in The Washington Post of Sep 17, 2011 by Juliet Eilperin provides good insight into the related thinking

in USA. It is interesting to note that 241 dams were demolished between 2006 and 2010, and that most of the country's 80,000 dams were built more than 50 years ago. Similar to the 241 dams, which were demolished on the basis of safety, economics, and community welfare, there are lot more dams waiting to be decommissioned. Because of the potentially huge impact on our densely populated and poor communities from any unfortunate failure of dams, our society should consider all the related issues from the overall welfare perspective.

Whereas the central government has expressed its concerns regarding the down stream impacts of dams in Tibet across river Brahamaputra, the same government is encouraging a massive number of dams in its own territory ignoring the concerns of its own people.

IEP seems to favor a large addition to hydel capacity on the premise that most of the additional capacity projected by 2031-32 should come from small size power projects of unit/plant size of 25 MW. In this regard we have to consider the fact that small hydro have the similar negative impacts as big hydro. The negative impacts are less but power generation per project is also less. The Cost-Benefit Analysis would be identical. However, the negative impacts could be reduced by stipulating that only partial obstruction to flow of water across the river will be made and other similar strategies. Even the micro and mini hydro power plants, can be damaging to the environment, unless adequate care is taken. Until this is clearly stated, even small hydro cannot be termed as clean and sustainable.

> A financial analysis done on West Seti hydel project in Nepal, which is basically meant to export the energy generated to India, indicates that net revenue to the local economy will be very meager after allowing for the capital investment recovery and profits of the private investors. This has particular relevance to Himalayan states, which may view a large number of hydel projects as revenue earning mechanism by exporting generated electricity to other states.
>
> *(Source: Mountains of Concrete – Dam building in the Himalayas by Shripad Dharmadhikari);* [4.3].

Without taking the following issues into objective account, the real cost of dams to the society will be hidden:

- Comprehensive rehabilitation, which among other things shall mean rehabilitating the displaced people enabling them to lead the same or better quality of life on a sustained basis;
- In addition to the comprehensive rehabilitation of the people with

official land rights, the rehabilitation of all others, including the laborers, hunters, gatherers etc. who have been living in that area should also be taken up;

- Respecting the right to exist for the fauna, and protecting the endangered species of flora;
- In the case of a dam, the impact of water logging on the adjacent agricultural areas, and the likelihood of water borne diseases;
- Opening up the forests to outsiders with little respect for the local environment resulting in large scale illegal felling of trees and poaching; import of alien species through outsiders;
- Welfare of the locals who would find themselves in marooned villages because low lying areas would have been submerged; socio-economic impact on the locals etc;
- Reduced localized rainfall because of the reduced forest cover etc.
- Loss of medicinal herbs, and thus the livelihood of the gatherers of these herbs.

One of the arguments offered by the proponents of dam based hydro power is that it provides safety against floods. This argument has a weak basis looking at the annual floods we have been experiencing on the downstream of dams in Yamuna, Krishna, Godavari, Kosi etc. Recently Ganga river also has caused massive flooding despite the Tehri dam in Uttranchal. One cannot forget the disaster due to Morvi dam in Gujarath few years ago, and the recent flood damages in Surath, and in Mahanadi in 2011. Additionally, the huge impact on the river delta due to multiple dams has been conveniently overlooked by such proponents. A news report in Hindu of 7 Oct. 2010 has vividly described how a series of dams across river Indus in Pakistan has failed to prevent massive floods, and also how such floods are welcomed by the people at the river mouth because of massive ecological benefits of floods ('Floodwaters welcomed in Indus delta': Annexure 9).

The myth of flood control through dams is exposed in an article "The myth of flood control" as in Reference material at the end of the chapter. It concludes: " … Above all, what is required is a completely new attitude towards the problem of flood control. We must abandon the illusion that floods can actually be eliminated. Regardless of the brilliance of our scientists, the ingenuity of our engineers and the generosity of the World Bank, floods will continue to occur. But they need not necessarily cause disasters. On the contrary, throughout history, floods have been made use of by populations inhabiting river basins to irrigate and fertilise their fields in a perfectly sustainable manner. If floods could be brought once more under the joint control of the forests and the flood

plains, we too might learn to live with floods and derive from them still more sophisticated benefits."

As per a study by Himamshu Thakkar of South Asian Network for Dams, Rivers, and People (SANDRP), out of 228 operational hydel projects in India as on 31.3.2007, which were surveyed by him, 82% were underperforming with actual generation of electricity which was less than 50% of the design capacity. This situation is mostly due to overestimation of the hydro electricity potential of the individual projects or sedimentation or both. Sharavathy valley hydel project, in Karnataka, is known to have recorded full reservoir level of stored water only in 4 or 5 years out of 35 years since commissioning. Such overestimation of the hydro potential has resulted in many projects acquiring more forest /agricultural lands than required, and consequently might have displaced more people than was really necessary.

The study by Himamshu Thakkar also reveals that between 1995 and 2007 the electricity generation from the hydel power projects in the country has come down from 3.97 GWH per MW per year to 3.39 GWH per MW per year despite the fact that year 2007 saw a rainfall which was 105% of the long term average. This indicates gradual decline in the outcome of hydel projects, probably due to silt accumulation and other factors.

4.2 Environmental Impacts and Global Warming concerns

A major casualty of dam based power policy is the huge loss of bio-diversity in the form of forest wealth, loss of river based aquatic life, loss of agricultural /horticultural crops, loss of medicinal/herbal plants etc. It is very unfortunate that IEP has not considered the burden on our society in the form of economic and ecological cost of loosing these natural resources when advocating the full exploitation of hydro potential in the country.

While the proponents of dam based power projects would like to call them green energy options, the huge potential of GHG emissions from the submerged vegetation in the reservoir behind dams have been conveniently ignored. Such submerged vegetation emits Methane gas which is 21 times much more potent than CO_2 as GHG.

A huge deficiency in the river management policy of the country is the absence of any legal mandate to maintain a minimum flow in a river either with or without dams. This minimum flow called as environmental flow is considered crucial for the sustenance of aquatic creatures of the river and other flora and fauna dependent on the river. Without such a mandate some of the rivers have already become inconsequential, and many more are expected to go dry in the near future. No explanation will be needed to understand the impact of such reduced flow in rivers on the livelihood of people. Dams will contribute hugely to such reduced river flows either in small stretches or at the estuaries.

According to 2002 Central Water Commission Register of dams, India had 4,525 large dams (which are over 15 meters tall) including 475 under construction dams. As per a report by Ivan B.T. Lima et.al (2007): "Methane Emissions From Large Dams as Renewable Energy Sources " large dams in India are responsible for about 20% of the country's total global warming impact in the form of Methane, CO_2 and Nitrous Oxide. This study report, by Brazil's National Institute for Space Research, also estimates that Indian dams are the largest global warming contributors compared to dams in all other nations. These latest round of studies should help shatter the myth that power from large hydropower projects is clean.

Though the proponents of large dams have refused to acknowledge, and there is no strong scientific evidence of 'reservoir induced seismicity', the environmentalists continue to refer to anecdotal evidence for the same. 'Increased incidence of earthquakes known as Reservoir Induced Seismicity due to load put upon the earth' is a salient feature of the writ petition admitted in India's Supreme Court in 2011 (Civil Orig 6/2011; Bharat Jhunjhunwala v/s Union of India). The website of Wikipedia (http://en.wikipedia.org/wiki/Reservoir-induced_seismicity) throws some more light on the phenomenon, which indicates that reservoir induced seismicity, is indeed observed in different parts of the world, though the magnitude has not been high.

4.3 Social, cultural and heritage issues

Major societal issues associated in impounding water in large reservoirs are[4.3]:

- The river valleys in India have been human habitats with social, cultural, religious and heritage importance for thousands of years. Many of the old temples and other religious institutions, which have been a source of spiritual inspiration for centuries, may face permanent destruction from dams.
- Probably the most affected community from dams is the tribal community, who live in isolated places in a small number with distinct identity, language and culture. The influx of migrant workers from other parts of the country for construction can devastate their community life.
- Tribal populations normally have close ties with rivers, forests, hillocks and animals. With submergence of their sacred elements they will undergo extreme deprivation.
- Large influx of migrant workers from other parts of the country to be engaged in dam building activities will put the local communities under severe pressure due to social and economic issues: competition for natural resources such as land and water; increase in price and shortage in availability of construction

materials; pressure on language and culture etc.

- A large number of people in rural areas depend a lot on the rivers and streams. Hourly, daily and seasonal change in the river flow, due to the construction of dams, will impact them massively. Sharavathy tail race project in Karnataka is a glaring example. Being the fourth hydro electric project on the river Sharavathy, conditional approval was given to run it as a run-of-river scheme, but it has been operating as a peak load station severely affecting the ability of the downstream people to cope up with the sudden gushing of water during the peak hours of the day. Another example is that of Narmada valley project where a number of people were reported to have been washed away due to sudden discharge of water from one of the reservoirs.
- Such vulnerable sections of our society, who may not have any other professional skills, will struggle to earn their livelihood when they are displaced from their natural habitats.
- The people who will benefit most by the proposed large number of hydel projects are the project developers, but the consumers and the local people will face all the hydrological risks and economic difficulties.

Despite repeated cautionary advises from a number of related reports both from domestic and international communities, the project developers are alleged to continue to ignore the necessary measures while building hydel power projects causing many hardships to our communities. Our society can ill-afford to continue with less than diligent approach in all the related processes in order to achieve the long term welfare of our communities.

Our society's inability to effectively rehabilitate the project affected families (PAFs) should have been a major consideration for IEP. Sadly the same has not even been discussed. A renowned social activist Arundhati Roy has associated the growth of slums in Jabbalpur to the increase in height of Sardar Sarovar Dam. Narmada Bachao Andolan under the leadership of Medha Patkar has been highlighting serious mistakes by the concerned authorities for a number of years. Dr G D Agrawal's recent fasting to protest against hydel projects in Uttarakhand has focused on many crucial issues. As a welfare society, we cannot afford to ignore such societal concerns. Any development activity, such as building a hydro power project, should not put one or more sections of the society to such anxieties/deprivations.

In a press statement released on 29.1.2012, Matu Jansangthan (an NGO working to protect rivers), Delhi has stated that the Supreme Court of India has issued notice to Ministry of Environment and Forest and National Hydro Power Corporation on Two HEPs

named Kotli-Bhel 1A (195MW) and Kotli-Bhel 2 (520MW). It indicates that these dams are proposed on Bhagirathiganga and Ganga rivers in Uttarakhand. Kotli-Bhel 1A (195 MW) is proposed on Bhagirathiganga. The making of a 17 K.M. long reservoir would amputate Ganga from its last free stretch near the Holy confluence of Alaknandaganga and Bhagirathiganga, at "Devpryag". After Devpryag, it flows as Ganga. This proposed project is just after the two big reservoirs of Tehri dam and Koteshwer dam. The area is also very much prone to landslides. Proposed Kotli-Bhel 2 HEP (520MW) consists of a 32 K.M. long reservoir which will submerge the Holy Devpryag. The reservoir is supposed to stretch till the Bhagirathiganga and the Alaknandaganga. A triangular reservoir will come up around the Devpryag. The old Badrinath Marg for pilgrims is also likely to get submerged.

As is well known, the river Ganga and its tributaries have been given very high spiritual place in the ethos of Indian communities from time immemorial. Many local organizations as well as environmentalists are deeply concerned that such a large number of dams in Uttarakhand are likely to devastate many holy places and adversely impact the social fabric of the region.

There have been many independent reports on the issues of displacement and rehabilitation associated with large dams. One such report may sum up the concerns of the Civil Society in that regard. The Indian People's Tribunal on Environment and Human Rights headed by Justice Rambhushan Mehrotra (Retired Judge, Allahabad High Court) in its study report "Report of the Independent Inquiry Into the Status of Rehabilitation of Project Affected Families (PAFs) of the Sardar Sarovar Project in Maharashtra" released in March 2000, has referred to the poor treatment of the native people in cases[4.4].

"Report of the Independent Inquiry Into the Status of Rehabilitation of Project Affected Families (PAFs) of the Sardar Sarovar Project in Maharashtra"

"Adivasi people comprise 7% of the population of India but make up 70% of the displaced population. These figures are indicative of the Indian Government's attitude and apathy towards adivasis. Neither is their culture nor is their attachment towards their ancestral land respected. People who were evicted due to the first large dams in the 1960s have till date neither been given proper rehabilitation nor cash compensation."

"In most cases rehabilitation has meant tearing apart an otherwise closely-knit adivasi community and dumping them in inhabitable tin sheds. Rehabilitation has usually meant living in deplorable conditions without even basic amenities like water, food and medical aid. In the long struggle against the Sardar Sarovar Project (SSP) one of the main grievances has been that of the conditions of rehabilitation and the manner in which people are being displaced from their ancestral land and community. It was

because of the people's opposition to the rehabilitation process that the World Bank under pressure in September 1991 set up an independent review committee – the Morse Committee as it came to be known – to review the process of rehabilitation. The Morse Committee through its findings found the state of rehabilitation so pathetic that it advised the World Bank to pull out of the project and stop funding. This created history and the people who were to be affected by the Project hoped that the Government of India would learn a lesson."

4.4 Costs and benefits Analysis of hydro power projects

In view of the multifarious costs to the society of dam based power projects, the real benefit to the society has to be objectively analysed. Few case studies, wherein high level costs and benefits of dam based hydel project have been analysed, have indicated that the direct and indirect costs to the society are much higher than the benefits. It should be noted that in many such projects most of the benefits will accrue to the project developer whereas the costs are incurred by the larger society.

In a detailed study of costs and benefits of Kotlibhel 1B hydel project in Uttarakhand, Dr. Bharath Jhunjhunwala has meticulously listed a large number of costs (both tangible and intangible) to the society, which are never taken into account by the project developers. He shows that the total benefit and cost of Kotlibhel 1B HEP in this CBA are calculated as Rs.155.5 Crores, and Rs.931.8 Crores respectively, because of which the resultant economic value of the project can be a net loss of Rs. 776.3 Crores to Uttarakhand and the country (Annexure 10).

Because of another such study by a group of scientists the 210 MW hydel project, proposed across river Bedthi in Karnataka, was shelved in 1980s on the ground that the economic value of the biomass generated by the local forest identified for submergence by the dam waters was more than the energy equivalent of the proposed project (Annexure 11).

As a welfare society, needing concerted efforts to lift a substantial section of our population from the clutches of poverty, we cannot afford to ignore these externalities to dam based power projects. Whereas the electricity produced in hydel projects can meet the growing demand of electricity for some sections of the society, some other sections of our society such as the project affected people can be seriously impacted by such projects. Such costs to the larger sections of the society are generally ignored in the project cost estimates. The large number of hydro-electric power plants proposed under IEP must be subjected to rigorous analysis of all the costs and benefits (CBA) not only to an individual state

but also to the region and the country. Due to slow decay of plant matter submerged in the reservoir Methane (CH_4) gas gets generated and released to the atmosphere; Methane has much more potency than CO_2 as a contributor to Global Warming. In the context of Global Warming and Climate Change, which are being viewed by the scientific community with ever increasing concerns, the impact on bio-diversity and erosion of forest wealth and consequent emission of Methane in such CBAs has regional and global significance too.

Additionally, there is a need to decide whether the revenue from the hydel projects is worth accepting the adverse impact on economic, social, and environmental issues on the region and the country. This particular issue is of special significance because most of the additional hydro power potential is considered in Himalyan and North Eastern States, where the electricity demand of each state will not need the construction of so many additional power plants. Uttarakhand alone is reported to have more than 100 dam based hydro power plants under planning/approval/implementation. Arunachala Pradesh is identified with potential in excess of 40,000 MW of hydro power. There are reports of more than 150 dams planned for North Eastern states. Many Himalayan and North Eastern States are reported to be planning to build a large number of hydel projects basically to earn net revenue to the states. This policy needs a holistic review[4.5].

World Charter for Nature was adopted by consensus by UN General Assembly in 1982, to which India was a signatory. It has provided some guiding principles for protecting biodiversity. Some key principles are:

- Activities which are likely to cause irreversible damage to nature should be avoided.
- Activities which are likely to pose significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that the expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed.
- Environmental Impact Assessment should be thorough, be given sufficient time, and be carried out in an open and transparent fashion.

As a society do we have the necessary commitment for following these guidelines in an objective sense?

Through a rigorous analysis of costs and benefits many dams in USA are found to be unacceptable and are being decommissioned (Dr. Bharat Jhunjhunwala's book 'Economics of River Flow').

4.5 Alternatives to hydel projects as a revenue earner for Himalayan states

Most of the Himalayan and sub-Himalayan states are understood to be planning to exploit their rivers to generate electricity and to earn net revenue to the state. Their contention is that due to hilly terrain those states cannot have much revenue from agriculture and industries. Keeping in view the serious impacts of building large number of dams in Himalayas, it becomes obvious that these states should be looking for a development model which will ensure equitable development opportunities for different sections of the society, which will harness their rich biodiversity on a sustainable basis, and which can bring net economic benefits to the state as a whole.

In this regard some of the alternatives to hydro-electric projects in Himalayan states can be:

a) Increase the efficiency of the electric power sector in the state to the international level, which will make it a surplus state by a considerable margin, and earn revenue by exporting the surplus electricity without the huge costs of additional hydro-electric projects. The Himalayan states will not have huge demand for electricity, and hence if these states can optimize the existing electricity generation, distribution and utilization, they can earn substantial revenue by selling the surplus electricity to other states.
b) By efficiently managing the electricity infrastructure they can earn additional revenue by offering auxiliary services to the regional power grid such as (i) peak demand support, (ii) voltage/ MVAR support, (iii) spinning reserve. In a growing and complicated power system, such as Northern Regional Power System, these services have huge significance, and can fetch a substantial increase in electricity revenue to the state.
c) Invest a part of such additional revenue to generate more electricity from renewable energy sources such as solar, wind and bio-mass, which in turn can earn additional revenue, and also reduce the risk of uncertainty for state's own power sector associated with river flows in the future.
d) In view of the fact that some of these states are experiencing power surplus during summer and deficit during winter months, they should consider the option to go for long-term Power Purchase Agreement (PPA) with coal fired stations located elsewhere than to build more hydel projects to meet its own demand, basically because of the increasing uncertainty of monsoons.
e) The rich biodiversity available in these states can be leveraged to get substantial level of economic credits both from the central government and from the international community to maintain the tropical forests, which are considered to be safe bets against

Global Warming. Carbon Credits as envisaged by UNFCCC can be a very good tool in this regard [through a scheme of carbon credits for forest preservation, called Reducing Emissions from Deforestation and Forest Degradation (REDD)].

f) Forestry based and agro based industries, if carefully planned and operated, can be sustainable sources of employment to a large number of technically un-skilled populations of the state and can bring substantial revenue on a perpetual basis. These two areas would also greatly assist in the empowerment of local population than many large industries would do.

g) Since these states are the source for a number of interstate rivers, voluntary self-denial of the opportunity to build additional hydro electric projects should be leveraged to get compensation from the lower riparian states and the centre.

h) Develop these states as educational, tourist and medical care hubs for both the national and international customers. Because of their salubrious climate and scenic beauty, these states can be very good tourist destinations.

i) With service industries playing more and more important role both at the global level and the national level, IT and BT sectors can offer huge opportunities to these states. Service sector can provide more revenue and employment opportunities than the capital intensive hydro power sector. It is worth mentioning here that the contribution of services sector to Indian economy has been growing enormously over the years, and is also creating more employment opportunities. The situation of Karnataka can be a good example in this regard.

j) As per a report of estimation by a bio-scientist and former vice-chancellor of the Kumaon University, the total value of ecosystem services, including food production and raw materials that accrue from the forests in Uttrakhand alone (which has about 64% of its land covered by forests & trees) is worth US$ 2.4 billion each year. For a small state like Uttarakhand, which has an annual budget of about 10% of this amount, the positive influence on its people if our society pays even 25% of this forest cover value (as 'Green Bonus') to Uttarakhand every year can be tremendous. Such a Green Bonus should help the state to protect the forest ecology, and even increase it as compared to the destructive type of industries the state may choose for economic development. The situation seems to be similar in other Himalayan states also. Each of these states should be encouraged to protect and increase the forest wealth (through an effectively designed Green Bonus) by having a forest & tree cover of more than 33% (as per the national forest policy). A substantial portion of the budget of Rs. 40,000 Crores for the Green India Mission should be used to encourage the Himalayan states in protecting their forest wealth.

All these alternatives also can provide much more employment

opportunities to the state's people than hydro electric power projects, which are anyway becoming more and more automated to reduce the cost of manpower. Additionally, these alternatives are sustainable; people & environmental friendly; and pose minimum risks.

"The World Commission on Dams + 10: Revisiting the Large Dam Controversy" says in its review: 'While one of the key drivers of dam development remains the pressure to meet human needs for energy and water resources, there is a continued need to better explore, promote, develop, invest in, and replicate the variety of non-dam and less-destructive alternatives for providing water and energy development. In the ten years since the WCD, there has been inadequate investment in the kinds of non-dam and efficiency investments outlined in several papers in this volume.'

4.6 Lacunae in the project approval mechanism

Article 48A of the Constitution of India, reads: "Protection and improvement of environment and safeguarding of forests and wildlife. - The State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country". MoEF, which has the specific responsibility in this regard, is expected to address the following questions in an objective sense against the application for environmental clearance for every hydel project in order to meet its constitutional obligations.

- How much is the potential value of ecological services associated with forests and fresh water resources of Western Ghats or Eastern Ranges or Himalayas or sub-Himalayan ranges?
- Can the total value of these ecological services be ever equated to meager benefits of producing electricity from one or more hydel projects?
- Can we afford to loose rich forests of our country with such huge ecological value?
- Can we rehabilitate the endangered and endemic species of these bio-diversity hotspots effectively?
- How can be the letter and spirit of the National Forest Policy target of 33% forest & tree cover be achieved if we continue to destroy the natural forests of highest ecological value ?
- Since the sole objective of dedicated hydel projects is to generate electricity only, why should the suitable alternatives available to meet the electricity demand not be deployed?
- Can the Green India Mission, at a total budgeted cost of 40,000 Crores, be better than protecting the rich natural forests in tropical India?

Keeping all these discussions in proper perspective, the MoEF

should embark on bringing suitable changes to its relevant guidelines to address these serious concerns. The project approval process in the case of hydel projects should essentially include the following steps to ensure that only the most essential projects with least possible societal impacts are taken up for detailed analysis.

- Study of alternatives: Each DPR should be mandated to discuss and evaluate all the available options to meet the specific objective. In the case of hydel projects the sole objective is to produce electricity but there are many techno-economically viable and environmentally benign alternatives.
- Costs & Benefits Analysis (CBA): Comparative study of CBA of all the available options should be carried out to arrive at the best alternative from the society's perspective. The onus should be on the project proponent to demonstrate beyond reasonable doubts that the proposed project is the best option in the interest of the society. All direct and indirect costs and benefits to the society should be objectively evaluated in the DPR.
- Effective pubic consultation should be held with all the interested stake holders.
- An objective EIA with legal sanction to penalize incorrect assessment should be mandated.
- Provision for the stake holders to make presentation to Expert Advisory Committee (EAC) of MoEF before the final recommendations is made.

The approval process for setting up hydro power plants includes the Techno-Economic clearance from Central Electricity Authority (CEA). One would expect (as also the mandate by IE Act 2003) that CEA follows a diligent process of deliberating on all the related issues before providing the Techno-Economic clearance to hydro power plants. A decent understanding of the implications of dam based hydro power plants in recent years may indicate that either all the environmental impacts or social impacts of such projects might not have been fully accounted for while issuing such clearance OR the related conditions might have been violated by the project implementing authorities. There is also a feeling amongst the environmentalists that suitable alternatives to dam based hydro power projects might not have been objectively considered in such clearances.

It is surprising that many aspects of a hydel power project (such as spillage, water usage charges, loss of generation due to silt, methane emissions from reservoirs etc.) might have been missed in the techno economic feasibility reports. Another aspect is that while Governments are prompt in levying charges, its end use is

not monitored and it seems to being used as a means to bridge the budgetary deficit.

Author's own study of the Detailed Project Report as prepared by Karnataka Power Corporation (KPCLtd) for the 400 MW Gundya hydel power project in Western Ghats of Karnataka has revealed that no other options available within Karnataka to get the equivalent of peak power/annual electrical energy proposed to be obtained from the project were considered. The Western Ghats Expert Ecology Panel (under MoEF), which was alarmed at the potential damage to the environment and bio-diversity of Western Ghats in Karnataka from this project, and of the Western Ghats in Kerala from Athirapally hydel power project, has recommended that the environmental clearance for these two projects should not be accorded (final report submitted to MoEF in August 2011). In this context it should be a matter of great concern to the Civil Society that these two projects were relentlessly pursued by the respective state governments since many years, despite massive apprehensions from the public.

The seriousness of the popular opposition to the ill conceived hydro power plants may be indicated by a writ petition admitted in India's Supreme Court in 2011 (Civil Orig 6/2011; Bharat Jhunjhunwala vs Union of India) requesting directions to CEA to consider all the environmental impacts; perform costs & benefits analysis, and conduct effective public hearing before according Techno-Economic Clearance to a power project. Major issues raised in this petition are associated with the manner in which CEA is handling the 'techno-economic clearance' for hydel projects:

- The unscientific manner in which the clearances are granted;
- the environmental costs of generation of hydroelectric power is not taken into account while issuing environmental and Techno-Economic clearances; these have been ignored even while making forecast of electricity demand;
- the environment, the nation and its present and future generations will be compelled to suffer because of such costs;
- failure to consider environmental costs while granting Techno-Economic clearances by CEA was across the board for all such projects all over the country;
- unlimited increase in the generation of hydropower cannot be justified on the basis of Article 21 because sufficient electricity is already available in the country;
- Hydropower appears to be cheap because many environmental costs are incurred by the society and these are not accounted.

- Preamble of the IEAct2003 states "An Act to… promotion of efficient and environmentally benign policies." A responsibility is cast upon the CEA to ensure that the projects being given clearance are environmentally benign.
- That Section 3(1) of IEAct, 2003 requires the CEA to advise the Central Government on "optimal utilization of resources."
- As per section 8(1) of the IEAct, 2003 the CEA is required to examine that the proposed river-works will lead to the "best ultimate development of the river or its tributaries for power generation, consistent with the requirements of drinking water, irrigation, navigation, flood-control, or other public purposes." The word 'ultimate' in this Section points to the necessity of assessing long term sustainability of river and resources;
- Objective assessment of the social and environmental costs and fulfillment of other public purposes can lead to drastically different decisions as compared to Techno-Economic clearances as being provided now;
- MOEF also is failing to undertake a comprehensive assessment of benefits and costs of hydropower projects. There is no requirement for filing a Cost-Benefit Analysis under the EPA, 1986.

The petition by Dr. Bharat Jhunjhunwala in the Supreme Court of India also says:
The environmental costs imposed upon the people include those from: (1) Deterioration in quality of water; (2) Green House Gas emissions from reservoirs; (3) Loss of carbon sequestration, grazing and minor forest produce, biodiversity and aesthetic value from forests submerged in the reservoir; (4) Increased incidence of earthquakes known as Reservoir Induced Seismicity due to load put upon the earth; (5) Increased incidence of landslides; (6) Increased level and virulence of malaria and other water-borne diseases due to breeding of mosquitoes in the reservoirs; (7) Loss of aquatic biodiversity due to obstructions in free flow of rivers; (8) Harm to endangered wildlife such as Smooth-Coated Otter and Mahseer Fish; (9) Increased number of deaths due to busses falling into reservoirs; (10) Loss of crop and livestock yields due to lower temperatures; (11) Loss of livelihood of the local people from fishing and harvesting of sand; (12) Loss of aesthetic value of free-flowing rivers; and (13) Loss of social cohesion due to splitting of local society into pro- and anti-dam groups.

The Down to Earth magazine (issue Jan 31, 2012) has reported: "The Union environment ministry has given in-principle clearance to a proposed hydro-project on the Alaknanda river, a tributary of the Ganga, in Uttarakhand. The 300 MW project had been rejected twice by the statutory body which recommends forest clearances, the forest advisory committee (FAC). FAC says the project lies in

the buffer zone of Nanda Devi Biosphere Reserve (NDBR), a home to many endangered species." This is the sort of issues of huge concerns to the civil society because of which socially conscious people like Dr. Bharat Jhunjhunwala have approached the Supreme Court challenging the very basis of approval for hydro power projects. There have been many incidences when the approving authority and its agencies such as EAC and FAC have been found to be seriously lacking in objectivity by the Civil Society, as far as hydro power schemes are concerned.

A periodical magazine by name 'Dams, Rivers & People' by South Asian Network on Dams Rivers & People, New Delhi (www.sandrp.in) has been focusing on how various activities of our society are adversely impacting our rivers to such an extent that many of the rivers seem to be fast approaching the point of no return. Dam based hydro power plants are a major cause of concerns in this regard. The magazine has published few interesting news items in Nov-Dec 2011 issue:

(i) "Large Hydro in Himachal do no deserve CDM tag": CDM tag for large dam based hydro power projects, similar to UMPPs, seem to defeat the very purpose of UNFCCC in designing this mechanism. Environmental damage and conflicts which arise from the reallocation of land and water resources, and the potential for Methane emission from the submerged vegetation in the reservoirs should be major concerns; providing financial support to such projects may appear to be a cruel joke on the people dependent on the river.

(ii) "EC for relooking at CDM hydro credits": The news item indicates that European Commission has been advised by one of its studies to consider barring international offset credits from large scale hydro power projects. Some climate experts are of the view that such CDM credits may be blindly subsidizing the destruction of rivers. They are of the view that large dams impose significant environmental and social damage.

(iii) "Hydel units and silt affecting Teesta flow": The news report quotes River Expert Dr. Kalyan Rudra that in addition to the silt deposited on the riverbed, hydel power projects upstream in Sikkim and West Bengal have reduced the flow and volume of water in the river. Many environmentalists and observers of rivers have been raising concerns on the huge deleterious impacts of dams on downstream river ecology for decades.

(iv) "Fraudulent Hydropower Companies in Karnataka": The report says that a mini hydel project developer within the district of Hassan in Western Ghats of Karnataka has reportedly encroached into the pristine forests, illegally widening roads, disposing the

wastes into the local streams, and undertaking other illegal activities within the forests. The local forest officials have lodged an FIR against the developer. Environmentalists have been cautioning for many years against permitting even micro/mini hydel power projects for commercial purposes in Western Ghats for such reasons. Once permission to build civil structures and to take machineries inside the forests is given to such private industrial houses, they invariably flout the environmental conditions and cause destruction to forest environment.

(v) "Himdhara study on Sutlej: River Under Arrest": According to the researcher of the report, tunneling and blasting in the river to build dams for a string of hydro power projects in Himachal Pradesh has led to the drying of the river bed, caused soil erosion, land slide, changed climatic conditions, dried up natural water springs, and affected livelihood activities like apple cultivation.

(vi) "Three Gorges Dam triggered 3,000 earthquakes": It quotes a study by seismologists at the China Earthquake Administration indicating that the huge Three Gorges Dam on river Yangtse has significantly increased seismic activity along the dam's reservoir. About 3,429 earthquakes were registered in the province of the dam in 6 years since inundation began in 2003. This is only one of a series of instances of 'Reservoir-induced Seismicity" being reported from across the world.

There have been many magazines/ websites dedicated to care for the health of rivers, which have been warning the international communities for decades about the dangers involved in having so many dams. It seems reasonable to assume that in Indian scenario the dams, because of huge societal costs involved and because of better alternatives available, for the sake of hydro power alone are not really necessary from the society's overall welfare perspective.

Reference material

4.1: "Dams and Development: A New Framework for Decision-Making"; World Commission on Dams (WCD)
http://www.internationalrivers.org/dams-and-development-new-framework-decision

4.2: "International Commission on Large Dams (ICOLD)"
http://www.icold-cigb.net/

4.3: "Mountains of Concrete – Dam building in the Himalayas", Shripad Dharmadhikari - http://chimalaya.org/

4.4: "Report of the Independent Inquiry Into the Status of Rehabilitation of Project Affected Families (PAFs) of the Sardar Sarovar Project in Maharashtra"; The Indian People's Tribunal on Environment and Human Rights headed by Justice Rambhushan Mehrotra (Retired Judge,

Allahabad High Court); March 2000
4.5: "Sustainable Hydro Power Policy for Himalayan States", Indian Network on ethics and Climate Change
http://www.inecc.net/index.php?option=com_content&view=article&id=290%3Asustainable-hydro-power-policy-for-himalayan-states&catid=35%3Ageneral&Itemid=111

Other reference materials

"Economics of River Flows" Dr. Bharat Jhunjhunwala
"Economics of Hydro Power" Dr. Bharat Jhunjhunwala
"Elwha Dam removal illustrates growing movement: The Washington Post - Washington, D.C.
http://www.washingtonpost.com/national/health-science/elwha-dam-removal-illustrates-growing-movement/2011/09/13/gIQAZFjtYK_story.html
"THE COST OF LIVING" by ARUNDHATI ROY
http://www.hindu.com/fline/fl1703/17030640.htm
"Nothing green about 'green economy'": By Sudhirendar Sharma;
http://www.d-sector.org/article-det.asp?id=1722&idFor=1722
"Are Big Dams Leaving India High And Dry?" By Neeraj Vagholikar
http://www.sanctuaryasia.com/index.php?option=com_content&view=article&id=5289:are-big-dams-leaving-india-high-and-dry&catid=579:conservation
"Importance of Including Use and Passive Use Values of River and Lake Restoration", by John Loomis
Universities Council on Water Resources, Journal of Contemporary Water Research & Education, Issue 134, Pages 4-8, July 2006
"Advancements in the Field of Reservoir Emissons " Prepared by Dr. Payal Parekh, for International Rivers, December 2, 2011
"The Lessons from the three Gorges Dam for Northeast India"; By Peter Bosshard , The Arunachal Times, May 26, 2011, http://www.arunachaltimes.com/
"REHABILITATION OF HYDROPOWER - An introduction to economic and technical issues"; http://www.worldbank.org/water.
"The myth of flood control": Published as Chapter 4 of The Social and Environmental Effects of Large Dams: Volume 1. Overview. Wadebridge Ecological Centre, Worthyvale Manor Camelford, Cornwall PL32 9TT, UK, 1984. By Edward Goldsmith and Nicholas Hildyard.
'Evaluating the Tehri Dam, INTACH, New Delhi (1988)', Vijay Paranjpye
'High Dams on Narmada, INTACH, New Delhi (1990)', Vijay Paranjpye
'Rehabilitation Policy and Law in India: A Right to Livelihood'; (Edited 1997); Vijay Paranjpye

Relevant Websites of interest

International Rivers: http://www.internationalrivers.org/
Hydro wing of Central Electricity Authority:
http://www.cea.nic.in/wing_report.html
MoEF : http://moef.nic.in/index.php
NHPC: http://nhpcindia.com/index.aspx
South Asia Network on Dams Rivers and people (SANDRP):
http://www.sandrp.in/
Reservoir-induced seismicity: http://en.wikipedia.org/wiki/Reservoir-induced_seismicity

Chapter 5

Ambitious targets for nuclear power

– renaissance for a flailing industry?

Key terms: nuclear power; radio activity; nuclear fuel; nuclear park; nuclear spent fuel, Fukushima disaster, Chernobyl accident, nuclear accident, nuclear liability, nuclear establishment, safety concerns, alternatives

Chapter Summary

The impact of a wrong nuclear power policy will be much more severe on our densely populated and ill-prepared communities than that in developed countries. Hence, there is an inescapable requirement that various sections of our society should be taken into objective confidence before making any commitment to build additional nuclear power plants. In view of the fact that any unfortunate nuclear accident in our densely populated country can have unimaginable consequences, the Precautionary Principles as enunciated by the World Bio-diversity Convention in our developmental paradigm must be heeded to. An objective analysis of all the related issues on nuclear power, including the experiences from other parts of the world, is critical in arriving at the most appropriate decision for the welfare of the entire society. Cautionary advice from former heads of state such as Mikhail Gorbachev (Russia) and Prime Minister Naoto Kan (Japan) should be considered very seriously in pursuing with the nuclear power policy.

Even after nearly 6 decades of massive support by various governments around the world, the nuclear power has not enjoyed the common man's support to the extent one would have expected. While the Three Mile island in USA dented the confidence of its own people, the Chernobyl disaster shook the confidence of the whole world, and the Fukushima disaster in Japan has made many countries to review their reliance on nuclear power.

In the Indian context, the ambitious plan of the Indian nuclear establishment to increase the nuclear power capacity from the present level of about 4,800 MW (only 2.7% of the total installed capacity at the middle of 2011) to more than 275,000 MW by 2050

(as per DAE document of 2008 "A Strategy for the Growth of Electricity in India") raises many questions from the perspective of the welfare of our communities for hundreds of years to come. A dispassionate analysis of various issues involved in such a decision making has become critical, as indicated by strong opposition to setting up of nuclear power plants in different parts of the country. As a welfare society, we should not ignore the concerns of the people; many of them may be very legitimate.

Table 11: Major issues for the society with Nuclear power technology

Economic Issues	Demands large tracts of forests and fertile land; huge capital costs; long term waste management costs; serious shortages of nuclear fuels in India; impact on food availability subsequent to accidents; true costs to society can be huge; massive costs to society subsequent to an accident
Social Issues	Peoples' displacement and health; long term health implications; concerns in birth and genetic deformities; inter generational implications of nuclear waste;
Environmental Issues	Mining related pollution; radiation emission during operation and from nuclear wastes for centuries ; radiation contamination of air, water and land; contamination of food products

5.1 Technical & Economics Issues

IEP admits that India is poorly endowed with Uranium, and that the known sources within the country can supply only about 10,000 MW of power capacity based on Pressurised Heavy Water Reactor (PHWR). It also says that because of low grade Uranium ore available in the country, Indian nuclear fuel costs at least 3 times that of international supplies. It adds that the substantial Thorium reserve in the country should be harnessed by converting it into fissile material through three stage development: PHWRs, fast Breeder Reactors (FBRs), and reactors based on Uranium -233 and Thorium -232 cycle, which is still reported to be far away from reality. Yet IEP advocates a large and unrealistic addition to nuclear power capacity; an increase from about 3,700 MW in 2006 to 63,000 by 2031-32.

Observers of nuclear power industry have been of the opinion that whereas the nuclear establishment in the country has been making tall claims on the increased role of nuclear energy, the reality has been much less in successive decades after independence. On the basis of many plans and assuming optimistic development times, Dr. Homi Bhabha had announced that there would be 8,000 MW of nuclear power in the country by 1980. As the years progressed,

these predictions increased. By 1962, the prediction was that nuclear energy would generate 20,000 -25,000 MW by 1987 and by 1969 the AEC predicted that by 2000 there would be 43,500 MW of nuclear generating capacity. All of this was before a single unit of nuclear electricity was produced in the country – India's first reactor, Tarapur, was commissioned only in 1969! [5.1].

The reality has been quite different. Installed capacity of nuclear power generation in 1979-80 was about 600 MW; about 950 MW in 1987; 2,720 MW in 2000; and 4,120 MW in mid-2009. Despite the huge increase in electricity generation capacity in India, from a meager 1,800 MW in 1950 to 90,000 MW in 2000 and 147,000 MW in 2009, the contribution of nuclear power to the total power generation capacity is less than 3%.

The observers are also of the opinion that this utter failure has not been because of a paucity of resources. Practically all governments have favored nuclear energy and the DAE's budgets have always been high. The high allocations for the DAE have come at the cost of promoting other, more sustainable, sources of power. In 2002-03, for example, the DAE was allocated Rs. 33.5 billion, dwarfing in comparison the Rs. 4.7 billion allocated to the Ministry of Nonconventional Energy Sources (MNES), which is in charge of developing solar, wind, small hydro, and biomass based power. Despite the smaller allocations, installed capacity of the renewable sources was 18,455 MW in 2011 (as compared to 4,780 MW of nuclear power)[5.1]. That is, India's renewable energy capacity is about 4 times that of nuclear energy, despite the fact that the government expenditure on the latter has been many times that on renewable energy.

A less known DAE document of 2008 is "A Strategy for the Growth of Electricity in India" (http://www.dae.gov.in/publ/doc10/index.htm). Dr. Anil Kakodkar, AEC, delivered a public lecture at Indian Academy of sciences, Bangalore on 4 July 2008 referring to this document. A cursory look at this document can put even a nuclear power advocate to deep concern. This report indicates that DAE has a nuclear energy plan not covered fully in IEP 2006. According to it about 275,000 MW is to be generated through nuclear power technology by 2050, and it may mean a 6,000 MW nuclear park every 100 kM of the Indian Coastline. Though this stupendously ambitious plan (may mean adding on an average 16,400 MW of nuclear power capacity every year during next 40 years) sound hilarious to say the least, looking at what has happened so far in the last 50 years, it should be a matter of grave concern to our society because it indicates the determination of DAE to expand nuclear power capacity exponentially, and the scope for the denial of adequate financial resources to develop renewable energy sources.

The fact that not many nuclear power plants have been built for over 3 decades since the Chernobyl disaster in 1986 can say a lot about the true economics of building them. Few nuclear power plants are being built in China and India, but one cannot say that the true economics of building them have been objectively considered by the STATE agencies owning them.

As of 2011 only two new nuclear power plants were being built in Europe. One was by EDF at Flamanville in France. It was reported to be at least four years behind time and Euro 2.7 Billion over budget. The only other new nuclear plant being built in Europe was at Olkiluoto in Finland. Areva, the builder of this plant was reported to be four years late and Euro 2.6 Billion over budget. *[http://www.guardian.co.uk/business/2011/jul/20/edf-french-nuclear-reactor-delays]* *[http://www.guardian.co.uk/environment/2009/oct/19/nuclear-power-gas-coal].*

It is reported that the effect of the delay and ballooning costs at Flamanville 3 on the ultimate cost of the electricity produced, as per Jim Watson, professor of energy policy at the university of Sussex, is that the cost per kilowatt hour has jumped between 33% and 45% in the last few years. It is estimated that the cost is particularly sensitive to delays, as this widens the gap between the heavy capital outlay and the point at which money starts to flow back in.

However, India and China have continued to chart out ambitious plans to add nuclear power capacity against many odds. Nuclear power parks of huge capacities are planned at Jaitapura (Maharastra); Haripur (West Bengal); Fatehabad (Haryana); Kovvada (Andhra Pradesh); Chutka (Madhay Pradesh); Mithivirdi (Gujarath). These are in addition to the works going on at Kudankulam (Tamil Nadu) for another nuclear power park, which has run into heavy opposition from the locals. What is most disconcerting is that the government is pressing ahead with these proposals despite the fact that people everywhere, from Kudankulam, Jaitapur, Mithivirdi, Gorakhpur to Jadugoda and Gogi are fighting these projects vehemently.

When nuclear power was initially propounded as a possible source of electricity, it was touted to be so cheap that even metering its consumption was considered unnecessary. Today it is seen as the costliest source of electrical power. It is projected that at Jaitapura (Maharastra) the total cost of the proposed power capacity of 9,900 MW with 6 of EPR reactors could be about Rs. 200,000 Crores. This comes to about Rs. 20 Crores per MW. In comparison the cost of a coal power plant is about 7 - 9 Crores/MW, and that of a hydel power plant is about Rs. 8 – 10 Crores/MW. Even the cost of a solar

power plant, which was being dismissed as very costly till recently, is known to be less than Rs. 18 Crores /MW without any of the attendant risks of nuclear power. In view of the continuously dropping costs of solar power technology, there is already a projection that by 2017 the cost of solar power will compare favorably with that of coal power. So, even the cost aspect of nuclear power seems to be against the technology.

Long term storage of nuclear waste is a major issue requiring our attention. Even US, which has over 100 nuclear reactors and which depends upon nuclear power for about 20% of its electricity generation capacity, has not found a satisfactory answer to this problem. The U.S. government is reported to have invested $9 billion developing a storage site for nuclear spent fuel at Yucca Mountain in Nevada province, which is perhaps the most studied geological structure in the world. Despite this enormous investment in building an underground, secure storage site, Nevada's less than 3 million residents have refused to endorse the project as a result of safety and environmental concerns. If storing spent nuclear fuel deep inside a mountain surrounded on all sides by about 100 miles of empty desert is considered unsafe, it seems certainly odd that in India, where the density of population is very high and where we cannot afford to keep an area of 100 kM radius without habitation, it is not an issue at all.

In a related article Dr. M V Ramana has shown that the cost of a 235 MWe nuclear power unit at Kaiga, Karnataka is much more than that of a comparable size coal power unit at Raichur, both built at about the same time. Dr. M V Ramana has established with reasonable amount of certainty that the real cost of a modern nuclear power station is clearly higher than that of a comparable size coal based power station. If we also take into objective account the long term storage costs, insurance costs, government subsidies and all the associated environmental and health costs, the nuclear power will be much costlier than any other conventional power sources. Subsequent to Fukushima disaster, the requirement for additional safety features is expected to be stringent enough to make the cost of nuclear power even higher than the present costs. So, even the cost advantage of nuclear energy is not there anymore.

Mikhail Gorbachev, former President of the Soviet Union, has expressed his concerns in an article 'Chernobyl 25 years later: Many lessons learned'[5.2]. He has said: " … But it is necessary to realize that nuclear power is not a panacea, as some observers allege, for energy sufficiency or climate change. Its cost-effectiveness is also exaggerated, as its real cost does not account for many hidden expenses. In the United States, for example, direct subsidies to nuclear energy amounted to $115 billion between 1947 and 1999, with an additional $145 billion in indirect subsidies. In

contrast, subsidies to wind and solar energy combined over this same period totaled only $5.5 billion."

In an article, Dr. Michael I. Niman, a professor of Journalism and Media Studies at Buffalo State College has analysed the nuclear power cost: "Nuclear power operators creating problems and then foisting them onto the government to fix when they, as we unfortunately put it, go nuclear, is such a norm globally as to be codified in law. The potential risk from a nuclear accident is so huge as to be commercially uninsurable. In fact, if the nuclear power industry was left to fend for itself in the free market, it would instantly collapse, turning upside-down once risk gets factored into any equation. The risk of catastrophe is so high, and the potential catastrophe so large, that the cost of insurance, assuming hypothetically that it was available, raises the cost per kilowatt hour of electricity off of the charts."

In an article "India's nuclear chimera" Down to Earth magazine (Issue Aug.15, 2010) has covered the cost and time over runs in nuclear power plants, and has concluded that "Going by the Kudankulan example, India's nuclear power generation target is a pie in the sky."

The exorbitant capital and operating costs, cost and time over runs, subsidies and hidden costs in the Indian context of nuclear power plants have also been quietly ignored by the nuclear establishment. International studies have established that if we take into account the true costs associated with disposing nuclear waste, decommissioning the worn out plants, and insuring reactors against catastrophic failures into objective account, building nuclear plants in a competitive electricity market is not simply economical. If the import of technology and fuel are to be relied upon, the energy security becomes a major issue which has not been addressed by the authorities. It is very strange that Integrated Energy Policy has not dedicated much space for the discussion on nuclear power issues.

> As stated by Hazel Henderson, a columnist (Deccan Herald of 29.6.2010), "Nuclear energy, heavily subsidized since its inception, is still the most inefficient, expensive and hazardous way that humans have ever devised to boil water."

Ex-chairman of the Atomic Energy Regulatory Board (AERB) Dr. A. Gopalakrishnan opposed the central government's move to import light water reactors (LWRs) in the next two decades, saying it does not have justifiable technical or economic basis. On the costs of imports, Gopalakrishnan said a 700 MWe PHWR could be built with just Rs.8 crore ($1.8 million) per MWe, whereas the 1650 MWe French evolutionary pressurised reactors (EPR) at Jaitapur

costs over Rs. 21 crore ($4.7 million) per MWe.

There is also a considered opinion of the experts that due to exorbitant costs associated and the base load nature, nuclear power can be at best suited to rich societies with high per capita consumption. But for a poor country, like India, can it be a suitable option from a holistic perspective?

There seems to be growing skepticism even to finance the nuclear power. "Too many well known banks that otherwise have taken laudable steps towards sustainability, are still investing heavily in the nuclear industry, putting the world on the wrong energy track. Sustainable banking and financing nuclear energy are simply incompatible" said Johan Frijns, BankTrack coordinator (Annexure 12).

An illustration of how an objective consideration of direct/indirect costs and benefits to society of different options available can indicate the futility of pursuing large nuclear power plants such as the Jaitapura Nuclear Power project in Mahrastra. Whereas the proposal by the project proponents envisages building 6*1,650 MWe nuclear reactors at a total estimated capital cost of about Rs. 200,000 Crores (indicated by Dr. A Gopalakrishnan, former AERB Chairman), there are very many direct and indirect costs to the society, which are not included in this project cost. While the true benefits to the society from this project is estimated to be about 6,300 MW maximum power and about 44,000 MU per year of energy (after taking into account losses in the system), there are many alternative options available to our society to realize these two benefits at much less overall cost. Same thing can be said about the costs and alternatives of Kudankulam NPP in TN (Annexures 13A/13B).

The proposal to have a nuclear power park with 6 * 1,650 MW EPRs at Jaitapura (Maharastra) to be supplied by Areva France has raised many serious concerns from the point of safety and costs. Professor Steve Thomas (PSIRU Business School, University of Greenwich, London) in article with the title " the EPR in Crisis" in November 2010 has said : The Olkiluoto order, placed in 2003, should have been on-line in 2009 and should have been a demonstration of the qualities of Generation III+ designs in general and the EPR in particular. However, by 2010, the EPR appeared to be in crisis. The two orders on which significant construction work had been completed had gone seriously wrong, obtaining safety approval from regulators in Europe and the USA was proving far more difficult than had been expected, estimated construction costs had increased by a factor of at least four in the past decade and the EPR had failed to win orders in bids for tender for nuclear capacity. Relations between the two state-controlled French companies at the heart of the development of the EPR,

Areva, the vendor and Electricité de France (EDF), the utility appeared at breaking point. EDF was reportedly contemplating designing two new reactors in competition with those offered by Areva.

In this context a very valid question raised by the Civil Society is: why the government cannot consider such benign options as compared to the costly/risky option of nuclear power.

5.2 Safety concerns for the Public

Since each of the three techno-economic super powers (USA, Russia and Japan) has experienced the nuclear emergency from their power plants, the very wisdom of relying on nuclear power technology is being increasingly questioned for the less endowed countries. If such resource rich, knowledgeable and quality/safety conscious countries could not avert nuclear emergencies, can our densely populated and ill-prepared society ever hope to avert the possible human catastrophe from a nuclear mishap?

While the country is fortunate that there have been no major accidents in the nuclear establishment, the observers are of the opinion that adequate safety of operation in the nuclear facilities within the country cannot be guaranteed for various reasons. While more and more complex safety systems/redundancies are being designed and built for the overall safety of nuclear power stations, it should be noted that they are only increasing the number of sub-systems and the complexity. Such complex systems can result in increasing the risk of failure of individual sub-systems/ sub-components (because of unintended/ unexpected interaction between sub-systems), and increasing new accident modes. All these can result in an increase in the number of automatic shutdown of reactors or catastrophic failures. The rapidity at which a minor problem in the complex system of safety can escalate into a major disaster is great in a nuclear power station, as experienced at Chernobyl.

Tall claims have been made about the capability of Indian nuclear establishments, especially the Atomic Energy Regulatory Board (AERB), to ensure complete safety of nuclear power projects. The fact that the people manning AERB are generally deputed from Department of Atomic Energy (DAE) OR Nuclear Power Corporation Ltd., which is the operator of the nuclear power plants in the country, cannot assure the complete operational independence of AERB. As far as Chernobyl disaster is concerned Indian nuclear authorities have said that "… secrecy was part of the Soviet culture..." How transparent are the issues with our own nuclear establishments? Dr. A Gopalakrishnan, former Chairman of AERB, has expressed concern about the complete dependence of AERB on DAE for resources. He says: "There needs to be a total re-

organisation of the AERB, making it totally independent of the DAE secretary and made technically much stronger with the recruitment of reputed senior specialists into that organisation. Today, the AERB merely serves as a lap dog of the DAE and the prime minister's office (PMO)."

In an article on 26.4.2011 Dr. A Gopalakrishnan has recommended: "The nuclear safety audit reports from 1979, 1986, and 1995 and a detailed action taken report corresponding to each of these audits must be submitted to parliament and made publicly available through the websites of the DAE and NPCIL. The same shall also be done in the case of the current post-Fukushima safety audit report ordered by the PM. "

While the nuclear emergency caused by Tsunami/earthquake in Japan in March 2011has thrown up many critical issues even in a safety and quality conscious country like Japan, it is very hard to imagine that the powerful and secretive nuclear power sector in our country (a country generally not associated with honest and good quality practices) has taken all the essential and adequate precautions to avoid such nuclear emergencies. It is even more critical to ask ourselves whether a densely populated and resource constrained country like ours can afford to take risk of a nuclear emergency?

It will be pertinent to note that, consequent to the nuclear emergency at Fukushima, Dr. A Gopalakrishnan has expressed serious concerns about the nuclear power park plans (of multiple units of huge capacity in single location). Dr. A Gopalakrishnan has said: "The people of India face a serious dilemma. The Fukushima incident has clearly brought out the reality that a nation far more technologically capable, better organised, and disciplined than India is today suffering seriously from a nuclear catastrophe. Out of sheer arrogance and ignorance, the government of India and its nuclear agencies do not wish to pause and debate the issues, but would rather move on in a hurry after a sham of a safety audit, which is conducted by a captive regulatory agency, as they have done three times in the past."

On safe practices in nuclear industry in India, Dr. A. Gopalakrishnan has the following to say: "The Japanese are the world's best experts in earthquake-resistant designs. They are also most knowledgeable in protective designs against tsunami impact. Japan is a country that has a superb disaster management organisation throughout their nation, and an often-rehearsed working team to handle such emergencies." "In contrast, in India, we are most disorganised and unprepared for the handling of emergencies of any kind of even much less severity. The Atomic Energy Regulatory Board's (AERB's) disaster preparedness

oversight is mostly on paper and the drills they once in a while conduct are half-hearted efforts which amount more to a sham." An insightful article, "The missing safety audits" by Dr A Gopalakrishnan poses many serious concerns on the safety aspects in the nuclear establishment of the country (Ref. 5.3). As a welfare society with a hugely dense population, can we afford not to take cognizance of such concerns by a former Chairman, AERB? Can we expect the Civil Society to be rest assured until all the concerns raised by such experts are addressed satisfactorily?

Mr. Jairam Ramesh, the minister for Environment & Forests also was reported to have written to PM seeking review of the largest nuclear power park proposal at Jaitapura, Maharastra.

Dr P Balaram, director of the prestigious Indian Institute of Science, Bangalore and part of Prime Minister Manmohan Singh's scientific advisory council, described the events in Japan as "a wake-up call" for India. In an open letter, signed by more than 50 prominent figures, Dr. Balaram has stated: "In the light of what has happened in Japan.... we strongly believe that India must radically review its nuclear power policy for appropriateness, safety, costs, and public acceptance, and undertake an independent, transparent safety audit of all its nuclear facilities, which involves non-DAE experts and civil society organisations. Pending the review, there should be a moratorium on all further nuclear activity, and revocation of recent clearances for nuclear projects," said Dr Balaram. He said he agreed to be a co-signatory to a key petition seeking a nuclear moratorium because many of India's proposed nuclear plants were likely to come up in populated and ecologically sensitive areas.

The proponents of nuclear power in India project it as a very safe technology. But the reality in Indian conditions seems to be vastly different. In an article by rediff NEWS at rediff.com on 4th October

As per Dr. Helen Caldicott, founder of Physicians for Social Responsibility and the author of "Nuclear Power Is Not the Answer":
"Nuclear power is neither clean, nor sustainable, nor an alternative to fossil fuels— in fact, does it add substantially to global warming. Solar power, wind energy and geothermal energy, along with conservation, can meet our energy needs. At the beginning, we had no sense that radiation induced cancer. Marie Curie and her daughter didn't know that the radioactive materials they handled would kill them. But it didn't take long for the early nuclear physicists in the Manhattan Project to recognize the toxicity of radioactive elements. I knew many of them quite well. They had hoped that peaceful nuclear energy would absolve their guilt over Hiroshima and Nagasaki, but it has only extended it. Physicists had the knowledge to begin the nuclear age. Physicians have the knowledge, credibility and legitimacy to end it."

2010 under the title "197 suicides and 1,733 deaths at India's nuclear establishments in last 15 yrs", it was mentioned that "197 employees belonging to a number of nuclear establishments and related institutes in India have committed suicide and 1,733 scientists and employees belonging to these centres have died of illnesses like multiple organ failure, lung cancer, cirrhosis of liver etc, as per a report compiled by Mumbai-based RTI activist Chetan Kothari." (Annexure 14).

A new dimension to the public safety is the 'nuclear terrorism'. In this regard Mikhail Gorbachev had expressed his concern in his article "Chernobyl 25 years later: Many lessons learned". He says: "…. I also remain concerned over the dangers of terrorist attacks on power reactors and terrorist groups' acquisition of fissile material. After the heavy damage wrought by terrorist groups in New York, Moscow, Madrid, Tokyo, Bali, and elsewhere over the past 15 years, we must very carefully consider the vulnerability of reactor fuel, spent fuel pools, dry storage casks, and related fissile materials and facilities to sabotage, attack, and theft. While the Chernobyl disaster was accidental, caused by faulty technology and human error, today's disaster could very well be intentional."

Mikhail Gorbachev's caution of wisdom also included: "First of all, it is vitally important to prevent any possibility of a repetition of the Chernobyl accident. This was a horrendous disaster because of the direct human cost, the large tracts of land poisoned, the scale of population displacement, the great loss of livelihoods, and the long-term trauma suffered by individuals yanked from their homeland and heritage. Victims of the tragedy were confronted by a crisis which they could scarcely understand and against which they had no defense. The material damage inflicted by Chernobyl, although enormous, pales in significance when compared to the ongoing human costs. The true scope of the tragedy still remains beyond comprehension and is a shocking reminder of the reality of the nuclear threat. It is also a striking symbol of modern technological risk."

The news paper DNA had carried an article on Jan 14, 2012 under the title "DNA investigations: Deaths confirm cancer risk near N-reactors". It said: "After being in denial for years, the department of atomic energy (DAE) has for the first time admitted that the deaths of its employees at the Kalpakkam nuclear site and their dependents were because of multiple myeloma, a rare form of bone marrow cancer linked to nuclear radiation. In response to a Right to Information (RTI) query in October last year, the DAE said nine people, including three employees working at the Kalpakkam atomic reactor, about 70km from Chennai, died of multiple myeloma and bone cancer between 1995 and 2011. The department had earlier refused to divulge information despite an RTI query in 2010."

The year 2012 seem to have opened with news that Fukushima's radioactive cloud may already have killed some 14,000 Americans, according to a major study just published in the International Journal of Health Services (International Journal of Health Services, Volume 42, Number 1, Pages 47–64, 2012). Unfortunately there seems no such compilation of the related health statistics from other parts of the world. If we consider the impact of Fukushima's radioactive cloud on other nations also, the implications may be massive. It is this sort of health concerns that the well meaning opponents of nuclear power are highlighting.

In a presentation with the title "Why a Future for the Nuclear Industry Is Risky" Peter Bradford, Former Commissioner, US Nuclear Regulatory Commission lists many concerns as below:

- NUCLEAR POWER PLANTS ARE STATED TERRORIST TARGETS:

  A SUCCESSFUL ATTACK COULD HALT NEW CONSTRUCTION EVEN AFTER SIGNIFICANT EXPENDITURE
- USED NUCLEAR FUEL STORAGE REMAINS UNRESOLVED
- ON GLOBAL WARMING: THERE ARE MUCH BETTER SOLUTIONS

There have been suggestions from Indian nuclear authorities that the safe storage of nuclear waste is technically feasible during its active life time. Is it really so, and even if it is so, what about the huge costs involved? Are the efforts/costs to keep nuclear waste safe for thousands of years worthy of all the risks involved? In this regard there are credible and serious concerns that whereas the present generation may get the benefit of electricity from nuclear power, the future generations have to deal with all the risks and costs associated with the spent fuel. Is this fair or socially responsible?

> In the case of a complex technology such as nuclear power the true value and the credible risks to the entire society, including the flora and fauna, and general environment should be determined objectively.

The nuclear emergency at Fukushima, Japan on 11th March 2011 has rightly focused on the question whether the nuclear power technology is a safe way to obtain electricity. There are reports from Japan that the bill for the Japanese society from the Fukushima accident may range between five and 10 Trillion dollars. Such a cost can be gigantic in the case of India as a densely populated society. There has been a groundswell of concern on the safety of nuclear power technology in various parts of the world

including Switzerland, Germany, US and China. The insistence of the nuclear reactor suppliers/builders to get a waiver for them on the nuclear damages liability, and the refusal of any insurance agencies to provide insurance against nuclear accident are moot points in this regard.

Prof. Atul H. Chokshi, Indian Institute of Science, Bangalore, says in an article "Nuclear Riddles: TINA and NIMBY ": Although nuclear authorities in many countries claim to have examined the Fukushima disaster and made modifications to existing plants, one lesson that has not been learnt is the need to avoid placing multiple reactors in one location, as a problem in one reactor can limit physical access to other nearby reactors, leading potentially to a domino effect and cascading problems. It appears that the nuclear industry has traditionally built two reactors adjacent to each other, perhaps to reduce cost by sharing common facilities and for other logistical and administrative reasons; the Fukushima disaster suggests a need to re-evaluate and possibly discard this historical legacy. Nuclear reactors in India require an exclusion zone with a radius of 1.6 km, and a sterilized zone with a radius of 5 km, with activities being limited to allow only for natural growth in the zone between 1.6 and 5 km.

It is a sector on which the govt. is known to be spending large amounts of national resources, because of which much more discussion of the related issues should have been held while formulating recommendations in IEP. Unfortunately, the views of Dept. of Atomic Energy and the personal views of nuclear power proponents seem to have been simply accepted. The fact that not a single a nuclear reactor has been approved in USA or UK after the Chernobyl disaster; the difficulties faced in 1-2-3 agreement with USA; and public opposition to Nuclear Damages Civil Liability Bill etc. should be taken into objective account while forming an opinion on nuclear power policy for the country.

5.3 How essential is nuclear power to Indian scenario?

The debate as to whether nuclear power is a safe, suitable and essential option for India has been going on for many decades. While the proponents of the nuclear power have been offering many arguments in favour of the option, there have been any numbers of issues raised by those who consider it to be not the best solution to meet the legitimate energy requirements of our society on a sustainable basis. The fact that despite massive funding of nuclear establishment in the country for over last 5 decades, the installed nuclear capacity as on 2011 was only 2.7% of the total installed power capacity, may indicate the true relevance of nuclear power to India.

Pro-nuclear advocates have started arguing that nuclear power is a good option against Global Warming since they do not emit GHGs. Observers (such as Dr. MV Ramana) are of the opinion that floundering nuclear establishments around the world, including India's, have grabbed this second opportunity (of arguments w.r.t Global Warming), and have made claims for massive state investments in the hope of resurrecting an industry that has largely collapsed due to its inability to provide clean, safe or cheap electricity. Two assumptions made by such pro-nuclear advocates are fundamentally flawed. One is that Global Warming can be contained without fundamentally changing the Western pattern of energy consumption; because nuclear energy is a tiny contributor to energy mix world wide (hence has no discernible impact on Global Warming). It is generally considered to be impossible to contain Global Warming, through a particular power generation technology alone, without significantly reducing the energy consumption levels of Western/ developed countries.

The second flawed assumption is that adoption of nuclear power can make sense as a strategy to lower aggregate carbon emissions. In this regard an example of Japan, a pro-nuclear energy country is given. As Jinzaburo Takagi, a Japanese nuclear chemist, has showed, from 1965 to 1995 Japan's nuclear power plant capacity went from zero to over 40,000 MW. During the same period its CO_2 emissions increased from about 400 million tons to about 1,200 million tons. Increased use of nuclear power did not really reduce Japan's emission levels[5.1].

Additionally, the amount of energy consumed in the entire nuclear fuel cycle from the mining stage till its radio active emission gets reduced to safe levels after hundreds of years is estimated to be colossal. Hence even though there are no GHG emissions during the operation of nuclear reactors, the total energy its life-cycle consumes has to come from other sources of power such as coal power plants, which themselves emit a lot of GHGs. The contribution to atmospheric pollution at the stages of nuclear fuel mining and processing, and radiation leaks to atmosphere are not inconsiderable.

On the basis of a 'Dynamic Energy Analysis of the Indian Nuclear Power Programme' R. Ashok Kumar of Mumbai argues that on an average the power consumed in various processes during the life cycle of the nuclear fuel in India is more than the power that is generated by that nuclear reactor. (Reference: http://energyauditnuclearprogrammeindia.blogspot.com/).

Taking all these facts into objective account it is certain that nuclear power cannot be termed a source of clean and green energy, and that it cannot be accepted that large addition to its

capacity worldwide will be able to reduce the Global Warming impacts. There are much better, cheaper and safer options.

In an article, "Too hot to handle? The future of Civil Nuclear Power" Frank Barnaby and James Kemp of Oxford Research Group have discussed why the nuclear power cannot be an acceptable option in the future, even from the Global Warming considerations. They point out that if nuclear power were to play more than a marginal role in combating global warming then some nuclear-power reactors would have to be operated even in these countries, where there is no nuclear power as of now. They have estimated that about 2,500 Nuclear reactors of average capacity 1,000 MWe would be required, and nearly four new reactors would have to begin construction each month until 2075. Looking at the past experience of slow growth, the increasing public opposition, the safety issues, and the threat of nuclear terrorism etc. such a huge addition of installed capacity is impossible.

As a part of long term power policy all the related issues w.r.t a technology must be considered. But in the case of nuclear power technology the issues relating to the environmental impacts of nuclear ore mining, radiation risks involved in the entire cycle, popular local opposition for locating a nuclear reactor in a given area, difficulties experienced in land acquisition, the threat of nuclear terrorism, the huge costs to the society, and the crucial issue of long term storage of spent fuel are not even referred to either by IEP or by other proponents of nuclear power. The huge opposition to Kaiga Nuclear power project in Karnataka; the ongoing massive opposition to Kundamkulam Project in Tamil Nadu; Tamil Nadu CM's letter to the centre to stop the construction work at Kundamkulam; the strong opposition to Jaitapur Project proposal; the cancellation of approval by West Bengal govt. to Haripur project proposal are all unambiguous signs that people of the country have not been convinced about the safety and usefulness of nuclear power. The unfortunate nuclear accident at Fukushima has brought about a paradigm shift in the way people are looking at the relevance of nuclear power.

The nuclear emergency at Fukushima subsequent to a strong earth quake and tsunami has rightly focused on the question whether the nuclear power technology is a safe way to obtain electricity to Indian conditions. There has been a groundswell of concern on the safety of nuclear power technology in various parts of the world including Switzerland, Germany, Japan, US and China. Japan, which was planning to increase the nuclear power capacity to about 50% (from the level of about 30%) in next few decades, has shut down many reactors as safety

precaution, and is reported to have taken a very conscious decision to reduce the reliance on nuclear power in the short term, and to eliminate the nuclear power from its energy basket in the long term. Germany, which had relied on nuclear power for about 26% of its power generating capacity, has taken a clear decision through a referendum to eliminate all its nuclear power plants by 2022. It is pertinent to note that since year 2000 the power sector in USA had proposed more than 150 coal power plants and seen them cancelled due to opposition from environmentalists. But not a single nuclear power project has come anywhere close to being approved during last 3 decades. In the overall context of tall claims by the nuclear power advocates it should be highlighted that Australia and New Zealand are the two countries who, despite having steadfastly maintained a 'no nuclear power' policy, have had no power shortages; hence, of course, the people there need not worry about risks of nuclear radiation. It is relevant to mention here that Australia has one of the largest reserves of nuclear fissile material and was refusing to sell the same to India in view of the NPT obligations. We need to appreciate as to why nuclear power has not been pursued in these countries, if the technology is safe, reliable, green, renewable, and of acceptable costs. The huge issues of capital costs and safety concerns were the primary reasons for the scenario in those countries.

As per IEP's projection even with about 13 times increases in capacity by 2031-32 (from present level of about 4,700 MW to 63,000 MW), nuclear contribution can only be about 8 % of the total capacity. As compared to this huge capacity addition projection many countries are planning to raise the percentage of renewables to about 20% of their energy mix. Being a tropical country India is endowed with much more renewable energy potential such as solar power than most other countries, which have shown determination to increase their renewable energy share to 20-25%. Israel is reported to be planning for about 50% share of renewable energy. As per a simulation by Greenpeace International, by 2050 India can meet around 65% of electricity and 50% of the Primary Energy demands from renewable energy sources.

The recent decision by the govt. to import large capacity nuclear reactors, such as the proposed 1650 MWe French evolutionary pressurised reactors (EPR) for Jaitapur, Maharstra has come under strong criticism by even the former nuclear industry people. "…The first objection is that the Evolutionary Pressurized Reactors (EPRs) to be built in Jaitapur, having not been commissioned anywhere in the world, is a non-existent

reactor whose potential problems are totally unknown even to Areva, its developer, let alone India’s Nuclear Power Corporation” Dr. A. Gopalakrishnan has said in a statement. Appealing to the government to 'immediately and permanently' cancel all plans to import foreign nuclear reactors irrespective of promises given by the prime minister to foreign governments, Gopalakrishnan also wanted the nuclear power policy of the government thoroughly debated in parliament and openly discussed with energy specialists in the country.

It should be preceded by a re-look of the overall energy policy of our country to assess whether all viable non-nuclear electricity generation schemes have been given their due priority, before we jump-start an extensive nuclear power programme,' Dr. A. Gopalakrishnan added.

Dr. A. Gopalakrishnan has said in another statement: “ … but most important, the PM must realise that there is absolutely no clarity or public confidence in the opaque nuclear power policy he is presently following. The PM has not provided any detailed justification for the unilateral promises he had made to import about 40,000 MWe foreign nuclear reactors by 2020, which appears to be at the heart of this baseless revised policy.”

> In view of the multifarious problems associated with nuclear power plants and its small contribution to overall power scenario in India even by 2031-32, and in view of credible concerns by very responsible leaders, our society should thoroughly review whether the resources made available for nuclear power sector is well spent on developing the new & renewable energy sources, which can eliminate all the thorny issues associated with nuclear power sector.

A less known Department of Atomic Energy (DAE) document of 2008 is "A Strategy for the Growth of Electricity in India”. Though the projected electricity demand of 1,500,000 MW by 2050 in this document looks vastly exaggerated from the social and environmental perspectives, the projection of 275,000 MW (as compared to 4,780 MW now) of nuclear power is what should greatly concern us. Though the projection of per capita electricity consumption of 5,300 KWH by 2052 (as per this document) seems grotesque, the audacity of DAE's plan is clearly worrisome because the nuclear establishment can be expected to go towards this goal with gusto.

As though it was not enough to hear a former head of nuclear power (Russia) advocating clearly against nuclear power, another head of the state, which also relied heavily on nuclear power till recently, has joined this advocacy.

Japan's Ex-Premier Turns Anti-Nuclear Activist
http://online.wsj.com/article/SB10001424052970204624204577180231906156286.html
"Former Japanese Prime Minister Naoto Kan returns to the world stage this week, part of a campaign to reinvent himself as a global antinuclear activist nearly a year after he oversaw his government's widely criticized handling of the Fukushima Daiichi accident. "I would like to tell the world that we should aim for a society that can function without nuclear energy," he said in a recent interview with The Wall Street Journal".

Dr. Buddhi Kota Subbarao, a former Indian Navy Captain with a Ph.D in nuclear technology from Indian Institute of Technology, Bombay has discussed many issues of serious concern to the society. In a detailed article "Whether Ordinance On Self-Denial Of Nuclear Power Harmful To India?" published in COUNTER CURRENTS.ORG on 11th June 2012 he has analysed why nuclear power need not be of any relevance to India. Among other conclusions he says: (i) There is an enormous harm in store for India if India becomes a market place and a testing ground for the so called new generation nuclear reactors pursuant to Indo-US Nuclear Deal; (ii) If India like Germany, decides to give up the pursuit of nuclear electricity and passes a resolution in both houses of Parliament to phase out completely the nuclear reactors in a planned time frame commencing with aged reactors, then there will be sufficient funds to invest in renewable sources of energy, like hydro, solar, wind, biofuels and in energy saving measures. That will help in ensuring the energy security of India. It will certainly save India from a possible unprecedented nuclear crisis of the type Japan is now facing.

In this article Dr. Subbarao has also pointed to the stark reality of the relevance of nuclear power in India. He says "In independent India, while more than 95% of energy research budget went to nuclear, the allocation for solar and wind is not even 1%. Yet, the contribution to the total electrical power production from nuclear is not even 3% of the total production".

Can we afford to ignore the wisdom of these leaders who have displayed the courage to tell the truth after their own experience?

5.4 Holistic view of overall costs of nuclear power to the society

In deliberating as to how much and what technology to be adopted in adding to the electricity generating capacity, there is a dire need to keep the overall costs and benefits to our society of such a technology in proper perspective. Any course of action we may take in order to meet the growing power demand in future will have deleterious impacts on our natural resources and

environment, as also on the vulnerable sections of our society. Hence there is an imminent need to take utmost care in minimizing such impacts.

A good decision making mechanism in this regard is Costs & Benefits Analysis, which will take into account all possible costs and benefits (direct and indirect, tangible and intangible) to our society in an objective way, and deliberate in detail on the best course of action in the overall benefit of the society. Any decision to build a nuclear facility (or for that matter any technology we may like to adapt) should be preceded by such a diligent process.

Since the contribution of nuclear power to the country's electricity basket is miniscule (only 2.7% of 180,000 MW), and keeping in view all the costs and potential threats of nuclear power technology in proper perspective the society has to take a diligent approach whether to continue with nuclear power. If Germany and Japan, with much higher percentage of nuclear power prior to Fukushima disaster, and with less potential in renewable energy sources, can take the bold decision to move away from relying on nuclear power, there should be no reason for India with much higher potential in renewable energy sources in doing so.

Participating in the fifth World Future Energy Summit (WFES) 2012, in Abu Dhabi, United Arab Emirates (UAE), on 16th January 2012, State Secretary, Germany, is reported to have stated that Germany aims to reduce its greenhouse gas emissions by 80% to 90% from 1990 levels by 2050, while simultaneously transforming its energy supply system to increase renewable energy generation to 80% by 2050. It is a significant statement to come from Germany, which was planning to increase its nuclear power capacity from a level of about 20% just prior to Fukushima disaster in March 2011.

Mikhail Gorbachev's caution of wisdom also included: "To end the vicious cycle of 'poverty versus safe environment,' the world must

From the report: "TOO HOT TO HANDLE - The Future of Civil Nuclear Power" by Oxford Research Group

"Many of the risks associated with civil nuclear power are well known and have, to some extent, been managed... just: recall Chernobyl, Three Mile Island, Hiroshima, the Cuban Missile Crisis, Iraq, Dr. A Q Khan and reports of al Qaida's plans. For the nuclear weapons proliferation and nuclear terrorism risks to be worth taking, nuclear must be able to achieve energy security and a reduction in global CO_2 emissions more effectively, efficiently, economically and quickly than any other energy source. There is little evidence to support the claim that it can, whereas the evidence for doubting nuclear power's efficacy is clear. Society should consider whether or not the risk that terrorists will acquire plutonium and make and detonate a nuclear weapon is unacceptably high".

quickly transition to efficient, safe, and renewable energy, which will bring enormous economic, social, and environmental benefits. As the global population continues to expand, and the demand for energy production grows, we must invest in alternative and more sustainable sources of energy—wind, solar, geothermal, hydro—and widespread conservation and energy efficiency initiatives as safer, more efficient, and more affordable avenues for meeting both energy demands and conserving our fragile planet."

"A transparent assessment of all the costs and risks associated with India's ambitious nuclear plans must be made before any ground is broken at Jaitapur or elsewhere." Says Siddharth Varadarajan , a senior columnist in The Hindu.

A study Finds that Childhood Leukemia Rates Double Near Nuclear Power Stations:
The study by the Institut National de la Sante et de la Recherche Medicale (French Institute of Health and Medical Research, or INSERM) found a leukemia rate twice as high among children under the age of 15 living within a 3.1-mile radius of France's 19 nuclear power plants. INSERM has carried out similar research in conjunction with the Institut de Radioprotection et de Surete Nucleaire (Institute for Radioprotection and Nuclear Safety, or IRSN) CEPA UMRS1018, team 6 for over two decades, but has never before found a higher incidence of leukemia. The report builds upon the findings of a German study published in late 2007 studying German children under 5 years old, which found that children of that age in the vicinity of German NPPs had suffered an increase in the incidence of childhood leukemia. "The case-control study included all the 2,753 French childhood leukemia cases aged up to 15 years at the end of the year of diagnosis, diagnosed between 2002 and 2007, and residing in metropolitan France. The cases were obtained from the French National Registry of Childhood Hematological Malignancies (NRCH)."

The seriousness of the opposition to the country's nuclear plans can be seen as exemplified by a writ petition filed in India's Supreme Court on Oct. 14 2011 by some of India's eminent citizens and organizations. The petition calls on the court to order a hold on nuclear construction until safety reviews and cost-benefit analyses are carried out for all proposed or existing facilities. The petitioners include E.A.S. Sarma, former power secretary; T.S.R. Subramanian, former cabinet secretary; N. Gopalaswami, former chief election commissioner; K.R. Venugopal, former secretary in the prime minister's office, P.M. Bhargava, former member of the National Knowledge Commission and founder of the Center for Cellular and Molecular Biology; and Admiral Laxminarayan Ramdas, former chief of naval staff.

In its appeal the group said India's nuclear program goes against the

"fundamental right to life" guaranteed by the Constitution, which the Supreme Court is bound to protect. Praful Bidwai, one of the petitioners, told Inside Climate News that India has a "poor culture of safety" and cited the 1984 gas disaster in the state of Bhopal, which killed thousands in its aftermath and from related diseases since.

In the light of Fukushima (2011), Chernobyl (1986) and Three Mile Island (1979) nuclear accidents (all of which happened after 1978) and the great concern they generated in the world during the last four decades, Dr. Helen Caldicott's 1978 book Nuclear Madness assumes prophetic significance. “As a physician, I contend that nuclear technology threatens life on our planet with extinction. All of us will be affected by radioactive contamination, unless we bring about a drastic reversal of our government's pro-nuclear policy,” she observed in the late 1970s. Caldicott drew the world's attention to the increased incidence of leukaemia and other forms of cancers and radiation hazards ever since the introduction of nuclear technology.

A society can ill-afford to ignore the concerns of so many informed individuals/reports as happening in the case of nuclear power policy in India. As a Precautionary Principle, as espoused by the World Bio-diversity Convention, it is prudent to be absolutely certain about the environmental and public health issues associated with nuclear power plants in India before the society decides to build more nuclear reactors OR continue to operate the existing reactors.

5.5 An inclusive decision making process on nuclear power policy

As they say “War is too important to be left to the Generals”, the decision on Nuclear Power is too critical from the perspective of the overall welfare of our communities to be decided by a handful of people in the nuclear establishment alone. The necessity for the active participation of all the stake holders within our society in informed decision making has become inviolable. In any such discussion on nuclear power in India a rational analysis on each of the following issues shall be of critical importance.

a) Despite huge investment in the nuclear industry since 1950s why the nuclear power capacity has not lived upto the tall claims of its Captains?

b) In the background of the fact that USA, USSR and Japan, which are all known to be the leaders in technological issues, and which are also generally associated with quality and safety issues, have failed to avert nuclear accidents, can India hope to have safe/accident free operation of all the existing/proposed reactors?

c) Can we say the decision by Germany and Japan to move away

from the reliance on nuclear power is ill-conceived? Have, Australia and New Zealand which have shunned nuclear power from the beginning, suffered from lack of quality electricity supply?

d) With the projected cost at Jaitapur nuclear power park (Maharastra) of about Rs 20 crore per MW, can nuclear power be said to compare favorably with coal power (about Rs. 7 Crore/MW), OR hydro power (about Rs. 8 crores/MW) OR solar power (about Rs. 20 crore /MW and which is coming down steeply)?

e) Are there better options to bridge the gap between demand and supply of electricity in a densely populated country such as India? Shall we not consider all the much benign options before we consider the nuclear power option, which has not gained popular acceptance even after 50 years of massive support?

f) Can we afford to accept the high risks (where 'risk' = 'probability of nuclear accident occurring' X 'consequences of such an accident') associated? How many of us are ready to live near a nuclear power plant/ nuclear facility knowing well the credible threat of radiation leakage?

g) In the background of three major nuclear accidents, and many near misses, can we afford to ignore the "precautionary principle" as enunciated by the international convention on bio-diversity?

h) Can we afford to ignore the caution by many reports/articles which have appeared in the media and by leading personalities such as Mikhail Gorbachev, UN Secretary General, Physicians for Social Responsibility, Dr. A. K. Gopala Krishnan, Dr. Balram etc.?

i) Whether the costs, which we need to pass on to the future generations (in safeguarding the nuclear waste for thousands of years), justifiable since there will be no benefits to these generations? How many times more electricity will the nuclear fuel cycle consume as compared to the electricity it can generate in its economic life cycle of about 40 years?

j) What are all the direct and indirect costs to the society of nuclear power as compared to the benefits in a poor country such as India? Are such benefits unquestionably higher than the costs? Through an objective study of Costs & Benefits Analysis, as a decision making tool, can we establish beyond reasonable doubts that every nuclear power plant in the country has more benefits than costs to the society?

k) Can the nuclear establishment in the country take the public at large for complete confidence by sharing all the relevant information?

l) How to ensure that all the stake holders are party to the carefully considered decisions on setting up nuclear power plants?

m) Can we convincingly say that none of the provisions of our

Constitution and various Acts of our Parliament will be violated by persisting with the nuclear power policy?

n) How have we taken the bitter experiences of nuclear establishment around the world into objective account while planning our own nuclear power policy?

Reference material

5.1: 'Nuclear Power in India: Failed Past, Dubious Future', M. V. Ramana March 2007, http://www.isn.ethz.ch.

5.2: 'Chernobyl 25 years later: Many lessons learned': Mikhail Gorbachev, Bulletin of the atomic Scientists (http://bos.sagepub.com/content/67/2/77.full)

5.3: "The missing safety audits" by Dr A Gopalakrishnan former chairman, Atomic Energy Regulatory Board, Government of India http://epaper.dnaindia.com/epapermain.aspx?edorsup=Main&queryed=9&querypage=8&boxid=30499718&parentid=139282&eddate=04/26/2011

Other reference materials

"Nuclear Power Is Not the Answer" by Dr. Helen Caldicott, Physicians for Social Responsibility

http://www.helencaldicott.com/books/nuclear-power-is-not-the-answer/

"Why should Jaitapur be made a guinea pig for untested reactor?" by Dr A Gopalakrishnan, former chairman, Atomic Energy Regulatory Board, Government of India

http://www.dnaindia.com/mumbai/comment_why-should-jaitapur-be-made-a-guinea-pig-for-untested-reactor_1520843-all

"The missing safety audits" by Dr A Gopalakrishnan

http://epaper.dnaindia.com/epapermain.aspx?edorsup=Main&queryed=9&querypage=8&boxid=30499718&parentid=139282&eddate=04/26/2011

"Chernobyl, Consequences of the Catastrophe for People and the Environment" by ANNALS OF THE NEW YORK ACADEMY OF SCIENCES, Volume 1181

"Health Effects of Chernobyl - 25 years after the reactor catastrophe": http://cndpindia.org/download.php?view.68

"Why A Future For The Nuclear Industry Is Risky" by Peter Bradford, Former Commissioner, US Nuclear Regulatory commission-

http://www.iccr.org/publications/risky_Jan07.pdf
“Too hot to handle? The future of Civil Nuclear Power” by Frank Barnaby and James Kemp, Oxford Research Group
http://www.hindu.com/nic/toohottohandle.pdf
“Rush in now, repent later” by Siddharth Varadarajan
http://www.hindu.com/2011/04/25/stories/2011042552931000.htm
“For nuclear sanity” by PRAFUL BIDWAI
(http://www.frontlineonnet.com/stories/20111021282110100.htm)
“Reactors, residents and risk” by Declan Butler
http://www.nature.com/news/2011/110421/full/472400a.html
“Nuclear fault lines run deep” Down to Earth (Issue: Apr 15, 2011)
http://www.downtoearth.org.in/content/nuclear-fault-lines-run-deep
DiaNuke.org is a resource page containing many insightful articles on nuclear information, resource, analysis and discussions.
http://www.dianuke.org/support-dianuke-org/
Department of Atomic Energy, Govt. of India: http://www.dae.gov.in/
Nuclear Power Corporation of India Limited:
http://www.npcil.nic.in/main/AboutUs.aspx
"A Strategy for the Growth of Electricity in India”:
http://www.dae.gov.in/publ/doc10/index.htm
“DNA investigations: Deaths confirm cancer risk near N-reactors”
http://www.dnaindia.com/mumbai/report_dna-investigations-deaths-confirm-cancer-risk-near-n-reactors_1637359
“AN UNEXPECTED MORTALITY INCREASE IN THE UNITED STATES FOLLOWS ARRIVAL OF THE RADIOACTIVE PLUME FROM FUKUSHIMA: IS THERE A CORRELATION?” International Journal of Health Services, Volume 42, Number 1, Pages 47–64, 2012 © 2012
“2012 Is the Year to Finally Bury Nuke Power” Published on Wednesday, January 4, 2012 by CommonDreams.org by Harvey Wasserman
“Childhood leukemia around French nuclear power plants – the Geocap study, 2002 – 2007”:
http://onlinelibrary.wiley.com/doi/10.1002/ijc.27425/pdf.
‘Dynamic Energy Analysis of the Indian Nuclear Power Programme’; R. Ashok Kumar
http://energyauditnuclearprogrammeindia.blogspot.com/
“Argument Against Nuclear Power Plant by someone who has built one”:
http://www.cndpindia.org/page.php?26
“The Story of Jadugoda, the chief source of India's Uranium”:
http://www.jadugoda.net/

Chapter 6

Environmental and Social Impacts

– major concerns to society

Key terms: Societal welfare, right to live, clean air, holistic view, natural resources, ecology, project affected people, acid rain, toxic sludge

Chapter Summary

Keeping in proper perspective the mandate of our Constitution, various Acts of our Parliament, the International Conventions for which India is a signatory, and most importantly the society's obligations to the vulnerable sections of our society, it becomes obvious that we need to adopt a paradigm shift so as to make the power sector environmentally friendly, with a high level of responsibility toward the bio-diversity. Global Warming is seen as an existential threat to which our power sector has been a major contributor. Unless urgent course corrections are applied, the power sector's contribution to the destruction of life on this planet will escalate through Global Warming phenomenon.

IEP's projection that the total electricity generating capacity should increase from about 160,000 MW in 2006 to 788,000 MW in 2031-32 would require addition of about 25,000 MW capacity every year for the 25 year period. This is a gigantic task, especially in the backdrop of our past experience wherein not even ten thousand MW could be added every year. Hitherto, the record for power capacity addition in a single year was in fiscal 2009-10, when 9,585 MW was added.

The social and environmental impacts on our society associated with such large scale additions, especially through conventional power plants, and the long term perspective of the welfare of the society has been ignored in IEP. The policy document seems to have ignored the fact that if social and environmental issues are not effectively addressed the economic wellbeing of various sections of the society will be severely eroded sooner or later. Hence the real challenge before the country is to ensure adequate quality/quantity of energy/electricity supply to all sections of the society, while taking care of the other needs of the society such as clean air, safe drinking water, healthy food, right to live peacefully in one's ancestral place, healthy environment etc.

Economic implications of the inefficient power sector on our society are enormous.

> As per the report of the 13th finance commission, which was tabled in the parliament on 25.2.2010, unless the public utilities engaged in transmission and distribution of electricity take urgent measures to improve the overall efficiency of operations the combined losses at the national level may increase from Rs. 68,643 crores in 2010-11 to Rs. 1,16,089 cores by 2014-15. Such huge losses have led to deprivation of adequate funding to other crucial sectors of our developmental process such as drinking water supply, poverty alleviation, health, education, rural infrastructure etc. Such huge losses year after year cannot be sustained, and will have huge deleterious impact on the developmental front. The huge addition proposed by IEP to the large size conventional power projects will lead to increase in such losses due to increased coverage of T&D network and due to the increased complexity of electricity network, unless the required course corrections are also undertaken urgently.

A common issue with any of the large size conventional power plant is the demand for large tracts of land, and natural resources like water and minerals such as coal or nuclear material. Being a densely populated country with limited natural resources, and struggling to uplift a sizeable percentage of the population from poverty, India cannot afford not being extremely diligent about how its natural resources are put to the larger societal welfare. There is a huge pressure on the land, especially the fertile agricultural land. Farmers generally refuse to part with their lands, which is so important to them from economic, social and emotional perspective. Forceful acquisition of such agricultural lands, which are their only source of livelihood, most often without adequate compensation, have been making these farmers very vulnerable to market forces.

> In 2000 the World Commission on Dams had stated: "Dams have made an important and significant contribution to human development, and the benefits derived from them have been considerable. In too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by tax payers and by the natural environment."

Whereas project affected people with legal rights to lands may get some compensation (however inadequate such compensation may be), generally there are more number of people who have no such legal rights, but who have been living in that area depending on common resources like water, forests, grazing fields etc. Such people and others like agricultural laborers, artisans, shop keepers, domestic helpers etc. will be affected by the projects but cannot get any compensation.

One of the common complaints against the developers of large projects is that much more than the really needed area of land is being acquired. Such a practice will render more people homeless than that number absolutely needed. Such extra pieces of land are either sold for a profit or left unutilized. In a country where the pressure on agricultural land is increasing heavily, the land acquisition process for any such projects have to be very pragmatic, and should always be monitored by a group of experts and local people. IEP seem to have ignored such issues.

6.1 General impacts on land, water and air – issues of serious concern to our communities

In her article "The Greater Common Good" Arundhati Roy, quotes a former Secretary to the Planning Commission, as saying that nearly 4 crore people have been displaced by dams alone in the country since independence. That's more than three times the number of refugees created by the Partition in India. It should be noted that a substantial percentage of such people have not been adequately rehabilitated, and have become impoverished, as can be seen by mushrooming slums. Should this not be a serious concern for a poor country like India? Power sector's role in such large scale displacement is not inconsiderable.

The hardship experienced by such project affected families (PAFs), as described by the media, has made others to be aware of the threats to their livelihood, and hence in recent years people are fiercely opposing forced acquisition of agricultural lands. Opposition to large conventional power projects are being reported regularly in the media. Some of such popular protests in recent years are: Dadri in UP (a large size gas power plant); Haripur (Nuclear Power Plant, West Bengal); a total of about 60 power plants in Vidarbha and Coastal Maharastra; more than 15 power plants in Vizag area of Andhra Pradesh; few coal power plants in Karnataka; a number of hydel power plants in Uttarakhand, Arunachal Pradesh and Sikkim etc.

A proposal for setting up 47 new coal power plants in the backward Vidarbha region of Maharashtra has met stiff resistance from various quarters as it will use up large portion of water in nearby rivers, which have much lower water flow due to poor monsoon in 2009 (Annexure 15). Such a large number of coal power plants totaling a power production capacity of 20,000 MW in one small area of a state will create havoc for its people, natural resources and environment.

As per the survey report by Prayas Energy Group (Ref. 2.1), if 700,000 MW of additional coal and gas power plants are to be set up, fresh water requirement of a huge quantity (about 4.6 billion cubic meters /per year) can be expected for these power plants.

The gravity of the situation becomes clear when we also realise that this much of fresh water can meet the drinking water needs of about 7% of the population in India, OR can provide irrigation to more than 900,000 hectares of land. When we also consider the sever shortage of drinking water in many parts of the country (and the fast depleting ground water levels), and the already low per capita availability of fresh water in the country, the stark reality of the impact of coal power plants become evidently clear.

Nuclear power plants also require huge quantities of fresh water for their operation. Such a requirement has been the major consideration for planning many nuclear power plants on the coast to enable the usage of sea water. However, there are many nuclear power plants operating/planned inland needing huge quantities of fresh water from the rivers. The combined impact of a large number of coal and nuclear power plants will be that the fresh water supply for our people will be seriously jeopardized with disastrous consequences. Even this fundamental aspect of conventional power plants has not been considered effectively by IEP.

As per CEA norms a coal power plant would need about 1 acre (0.4 Hectare) of land per MW of installed capacity, excluding mining area, and additional lands for transmission lines. At this rate additional coal power capacity (as per IEP projection) will need about 350,000 Acres (about 150,000 Hectares) of additional land, most of which is likely to come out of the agricultural lands. This, in addition to the land required for about 120,000 MW of additional hydel power and 50,000 MW of nuclear power, and the land required for the associated mines, transmission lines, townships, roads & railway lines may need about 0.5 million acres (0.2 million Hectares) of additional land. Finding suitable land of this size with minimum hardships to the affected people and avoiding usage of fertile agricultural/ forest lands seem almost impossible if we also take into account the competing demand for such additional lands from other sectors of our economy such as housing, urbanization, roads, railways, airports, SEZs, industrialization etc.. The associated popular opposition has the potential to lead to Singur / Kalinganagar/ Kudankulam type of social chaos. Can our society afford to ignore this sort of social unrest?

For the proposed number of coal power plants by 2031-32 the combined water requirements will be very huge (few billion Cubic meters per year). Many parts of the country are already facing severe shortage of water for drinking and agricultural purpose. With hugely growing population and penchant for additional large industries there will be unmanageable demand for water in the years to come; and huge addition to coal power capacity can make it a national crisis. A credible scenario would be the diversion of

fresh water sources to industrial purposes, including coal power plants, putting human welfare at great risk. With ground water removal already reported as being at unsustainable level and many rivers getting dried up for various reasons, providing fresh water supply to large number of additional coal power and nuclear power plants will pose serious socio-environmental problems.

Reports also indicate that a typical 500 MW coal power plant emits around 105 tons per day (TPD) of SO_2 (at 100 per cent load factor, 0.7 per cent sulphur content in coal), 24 TPD of NO_2 and 2.5 TPD of particulate matter (at 34 per cent ash content, 99.9 per cent electrostatic precipitator efficiency) and ash around 3,000-3,500 TPD. All these pollutants from coal power plants will be a major threat to our society (Annexure 9). It is very unfortunate that IEP has not even referred to either the impact of these pollutants or how they will be managed effectively.

One study estimated the amount of CO_2 emissions likely from a coal power capacity of 250,000 MW (as per one projection for year 2032). This estimate indicated that that at 70% PLF, these plants put together may generate 1,492,477 gigawatt hours (GWh) of electricity per year. At an emissions rate of 964.4 tons of CO_2/GWh, the resulting emissions of carbon dioxide could be 1.44 billion tons annually. This estimation when considered in the perspective that there can be about 450,00 MW of coal power capacity by 2031-32, the total CO_2 emission can be a huge concern from Global Warming perspective. It should be reminded that so much of CO_2 emission is also linked to emission of other pollutants such as particulate matter, heavy metals, SO_2 etc. The combined/cumulative impact of all these pollutants on the general health of the humans and flora and fauna can be calamitous. Considering the laxity with which the environmental regulations are implemented in India, the potential for such pollutants getting released into the atmosphere/ rivers/ lands is huge.

As a welfare society, with a large percentage of vulnerable sections, we have a duty of care to consider the rights of such people to live peacefully and in good health. Since the very idea of producing electricity is solely meant for the welfare of our communities, the reality behind so much of conventional power capacity must be kept in proper perspective.

6.2 The threat of Global Warming and Power Sector

In recent years the scientists, economists and political leaders have been convinced that the ecological, economic, social and political costs of climate change due to Global Warming would be very high. As IPCC has revealed through its reports, and as evidenced by the efforts of UNFCCC, there are no credible doubts about the

contribution of conventional power producing technologies to the causes of Global Warming. Global Warming and the destruction of bio-diversity through it are considered to be an existential threat to the human kind. Though there has not been any success in the international negotiations to come to a binding agreement as to how GHG emissions can be brought under control (except for a token agreement under Kyoto Protocol), the governments around the world have clearly recognized the need to reduce the GHG emissions drastically in order to save the bio-diversity.

It has been a great concern to the communities around the world, that while there is increasing evidence of the existential threat by the Global Warming various governments are not doing enough to minimize the GHG emissions from energy usage, such as burning of coal, diesel and natural gas. Power sector's contribution to Global Warming is the highest amongst the major economic sectors listed in table 12.

Table 12: Annual Green House Gas emission by Sector

Sector	GHG gases (%)	CO2 (%)	Methane (%)
Power Stations	21.3	29.5	-
Industrial Processes	16.8	20.6	-
Transportation fuels	14.4	19.2	-
Agricultural bi-products	12.5	-	40
Fossil fuel retrieval, processing and distribution	11.3	8.4	29.6
Residential, commercial and other sources	10.3	12.9	4.8
Land use and bio-mass burning	10.0	9.4	6.6
Waste disposal and treatment	3.4	-	18.1

(Source: IPCC Report 2009)

Indian government, itself, has never expressed any doubt about the need to contain the GHG emissions. It has come up with its own National Action Plan on Climate Change (NAPCC) to reduce the impact of Global Warming. Keeping these aspects of Global Warming alone in our perspective, the society needs to undertake a thorough review of past and present policies in power sector. India is said to be en route to becoming the second largest emitter of greenhouse gases globally. High GDP growth linked developmental pathway, as being advocated by the successive governments, will lead to high energy consumption, and consequently to high GHG emissions. In this context the need to minimize the overall energy consumption becomes very evident. In order to combat the Global Warming phenomenon, the need to

minimize the CO2 emission from the power sector becomes obvious because of the close association between electricity consumption and GHG emissions as depicted in table 13.

Table 13: Global Electricity Consumption and CO2 Emission (Year 2009)

Country	Per Capita Consumption(kWH)	Per Capita CO2 Emission (Tons)
United Arab Emirates	17,296	31.97
Sweden	14,141	4.48
USA	12,884	16.9
Australia	11,038	17.87
Japan	7,833	8.58
Germany	6,781	9.16
China	2,631	3.03
World Average	2,730	4.29
India	597	1.37
Indonesia	609	1.64

(Source: Key World Energy Statistics, IEA, 2011)

Looking at the large number of power projects advocated by IEP and those being planned/implemented all over the country it is hard to believe that the stated objectives behind the missions such as National Mission on Sustainable Habitat; National Water Mission; National Mission for Sustaining the Himalayan Ecosystem; National Mission for a "Green India"; National Mission for Sustainable Agriculture have any realistic chance of being fully met. In summary, it can be said that the much touted National Action Plan on Climate Change (NAPCC) may not have any discernible effect on the Global Warming potential of the country, if we are to persist with the continued/increasing reliance on conventional power plants.

In a report released in 2010 (India: Greenhouse Gas Emissions 2007) MoEF has indicated that the CAGR of GHG emissions from electricity sector between 1994 and 2007 was 5.6%, and that about 38% of all GHG emissions in our country is associated with electric power sector. Additionally, within the energy sector electricity alone accounts for 65.4 % of all GHG emissions. In view of such large contribution of electricity to the total GHG emission of the country, there is an urgent need for reducing the emissions from the power sector, which is possible only by minimising the number of large conventional power projects, and not by increasing them by a huge magnitude as recommended by IEP.

Table 14: Sector wise % GHG emission in India during 2007

	Energy	Industry	Agriculture	Waste
Electricity	37.8 %	-	-	-
Transport	7.5 %	-	-	-
Domestic	7.2 %	-	-	-
Others	5.3%	-	-	-
Cement	-	6.8%	-	-
Iron & Steel	-	6.2%	-	-
Others Industries	-	8.7%	-	-
Total	57.8 %	21.7%	17.6%	3.0%

(Source: MoEF Report in 2010)

A 2012 report by Asian Development Bank (ADB) by the title "Climate Risk and Adaptation in the Electric Power Sector" has focused on the possible impacts on different aspects of power sector due to Climate Change expected during next few decades. (http://www.adb.org/publications/climate-risk-and-adaptation-electric-power-sector).

It has listed a number of potential causes for concern. Some of them are:

- "By 2030, fossil fuels (coal, gas, and oil) are expected to continue to generate more than 70% of electricity in the DMCs (developing member countries). The power sector alone will continue to contribute approximately half of the region's total CO2 emissions by 2030, with a corresponding contribution to the increase in atmospheric concentration of greenhouse gases."
- "Climate change is expected to affect the entire electric power sector: fuel mining and production, fuel transportation to power plants, electricity generation, transmission through high voltage grids, and low voltage distribution to consumers. Patterns of energy load growth and end-use demand by consumers will also be altered by climate change. "

6.3 Impacts on flora, fauna, and general environment:

According to scientists the biodiversity is declining rapidly throughout the world, which is losing species at a rate that is 100 to 1,000 times faster than the natural extinction rate. Mass extinctions of species have occurred five times previously in the history of the world - last time was 65 million years ago when the dinosaurs and many other species disappeared. Scientists believe that now we are in the sixth mass extinction event, which is a result of a competition for resources between one species on the planet

- humans - and all others.

A report by MoEF "Achieving 2010 Biodiversity Target: India's contributions" has copiously described the rich bio diversity in the country, the threats to it and the tall claims about the remedial measures taken. As per State of Environment Report 2009 by MoEF India is a mega diversity country with only a 2.4 percent of land area of the Globe but accounting for 7-8% of the recorded species of the world. It is the home for 11.8% of the plant species documented so far. The National Forest Policy 1988 envisages that one third of the geographical area of the country to be covered by forests and trees, and considers it as essential for economic and ecological security of the country. But as per the MoEF's own admission this figure as at present is about 23% of which forest cover alone accounts for 21%. Only some of the Himalayan states have forest & tree cover of more than the national target, but all other states are known to have this cover much below 33%.

India also is reported to have the world's most toxic air. India scored a miniscule 3.73 out of a possible 100 points in the analysis, lagging far behind the next worst performer, Bangladesh, which scored 13.66. In fact, the entire South Asian region fares badly, with Nepal, Pakistan and China taking up the remaining spots in the bottom five of the rankings. In a study by Yale and Columbia Universities, India holds the very last rank among 132 nations in terms of air quality with regard to its effect on human health. The Yale Center for Environmental Law and Policy and Columbia's Center for International Earth Science Information Network have brought out the Environment Performance Index rankings every two years since 2006. The Index report was presented at the World Economic Forum held in Davos (January 2012). This can be seen as a clear indication of the poor focus for our society on environment, which is so important for the all-round welfare of our communities. Power sector's contribution to this sorry state of affairs is considerable in the form of ever increasing coal power plants.

Power sector, in its various facets, is a source of major concern w.r.t the threat to the flora and fauna. All the conventional technology electricity sources release many of the highly dangerous pollutants such as ash, heavy metals, Mercury, GHGs, SO_2, Nitric Oxides etc. from coal power stations; CO_2 from liquid fossil fuels, radiation from nuclear wastes; Methane gas from dams etc. Coal power stations are considered to be the worst polluters of air, land and water. Diesel, petrol, and natural gas used for power generation also are associated with GHG emissions. There are serious environmental issues with each of these fossil fuels whether in mining, processing or end usage. Though nuclear power generation is touted as clean process, the mining and processing of nuclear fuels have huge environmental

implications. The dam based hydro power projects may appear to be an environmentally clean option, but the submergence of plant matter through reservoirs is a source of Methane gas which is much more potent than CO_2 as a GHG. One estimate indicates that the GHG emissions from the dams in India are about 20% of the total GHGs emissions in India. Indian dams are also estimated to be emitting most Methane gas than dams in any other country. In this context it is not clear how IEP consider dam based hydel power as Green energy.

Acid rains due to Sulphur content in coal has been identified as a major threat to bio-diversity. Despite tall claims to reduce Sulphur di oxide emissions, coal power plants are reported to continue to affect the bio-diversity in the areas within 100 kM radius. Few years ago there was a report of Canadian forests close to border with USA, having been seriously damaged by the acid rains from the coal power plants of USA.

The conventional power sources are generally known to pollute the surrounding areas in one way or the other, and have deleterious impact on fresh water sources and atmospheric air. Plant kingdom around the coal power stations are reported to be affected badly by the coat of fly ash on the leaves. Nuclear fuel wastes are known to remain radio active for thousands of years, and coal ash from ash ponds are likely to wash to the nearby rivers/streams during heavy rains. There is always a lurking danger of breach of safety of storage of these wastes either due to natural or human reasons, as happened in USA in 1999. A coal ash pond ruptured and sent about a billion gallons of toxic sludge across 300 acres of East Tennessee.

Because of its huge & dense population, limited natural resources and long coast line, India is expected to be one of the most impacted countries due to Global Warming and Climate Change. As per Inter Governmental Panel on Climate Change (IPCC) some of the catastrophic consequences of Global Warning beyond 20 Centigrade increase are: famines and droughts threatening millions of lives; worldwide drop in agricultural and horticultural crops; up to 3 billion people at risk of flooding and without access to fresh water supplies; destruction of half the world's nature reserves and a fifth of coastal wetlands; global sea levels increase by more than 20 feet; significant effects on biodiversity and ecological productivity; potential for international conflicts, border disputes, war due to water and food shortages, forced migration, extreme weather events, huge impact on general health etc. It is not difficult to understand how each of these catastrophic consequences can impact our masses.

A major aspect of the natural wealth of the globe which gets

> As per Inter Governmental Panel on Climate Change (IPCC) - IV Assessment Report "Emissions from deforestation are very significant – they are estimated to represent more than 18% of global emissions"; "Curbing deforestation is a highly cost-effective way of reducing green-house gas emissions." Large conventional power projects are all major contributors for deforestation either through dams, buildings, mines, transmission lines and pollutants like coal dust, coal ash and acid rains.

severely impacted by conventional power plants is the bio-diversity. Being one of the earliest civilizations, our society has attached a great cultural and spiritual value to rivers and the rich biodiversity associated with them. However, since independence our treatment of rivers and the rich biodiversity associated with them has been one of grossly callous in nature. Dams for the purpose of hydro projects are large in number, and are contributing heavily for this ill-treatment of our rivers.

- A river is known to be most beneficial to the flora, fauna and humans only if its water is fresh and flowing continuously. One or more dams on a river will severely affect this characteristic of a river, and hence will deprive us of all the associated benefits.
- It is very disturbing to note that there are no legally mandatory norms in our country which stipulates the minimum fresh water flow in a river with or without hydro electric dams. Authorities seem to consider the water flowing to sea as a waste, without appreciating the need for such a flow to conserve the ecosystem. Such 'Environment Flows' are essential to maintain the ecological integrity of a river and its associated ecosystems, and of the goods and services provided by them.
- In view of the fact that most hydro electric projects involve diversion of river water through tunnels of many kM in length, if there is no minimum 'Environment Flows' the stretch of the river between the dam and the point where the water passing through the hydro turbines reenter the main course of the river will become dry. In many cases this stretch of a river can be few kM, and the river ecosystem in such a stretch could be destroyed.
- Dams prevent the silt from flowing down the river, and seriously affect the availability of rich nutrients to the bio-diversity down stream.
- The hilly terrains, where most of the dams are built in general, such as Himalayas and Western Ghats are not only recognized as bio-diversity hotspots but also as fragile ecosystems with many species of flora and fauna amongst the endemic types. Dam building activities like digging, blasting, excavations, dumping of debris, road building etc. are more than likely to severely damage the bio-diversity in these areas.
- Dams are known to have reduced populations of migratory fishes

or caused extirpation of genetically distinct populations, as well as diminishing estuarine fishes in most continents. In North America studies have revealed that fresh water extinctions due to dams are five times as high as those on land.

In this background all out efforts to mitigate and adapt to the Global Warming by reducing the Global GHG emissions to the lowest possible levels are considered an urgent necessity by the global community. Being a country with the second largest population India's potential to be one of the three biggest GHG emitters in the near future is credible. In view of the huge contribution of conventional power plants to Global Warming through emission of Green House Gases such as CO_2, Nitrous Oxide and Methane, our society has a duty of care not only to protect its own population but also to the international community in reducing the number of such conventional power plants.

Dr. Anand and Geeta Pereira, who are doing a great job in increasing the awareness on our forest ecology, have said in an article of October 2010:

The UN Brundtland Commission defines GREEN as meeting the needs of the present without compromising the ability of future generations to meet their own needs. Forest wealth, contributes significantly to long term economic performance and therefore should be considered as an economic asset. Forests are not only a source of timber, fuel wood, but also markedly influences local and regional climate, preserves soil from erosion, mangroves prevent flooding and trees act as stores of carbon and biodiversity. In the developing world some 75 per cent of all medicinal drugs are from forest plants.

- A single large tree can release up to 400 gallons of water into the atmosphere each day.
- One acre of trees produces enough oxygen for 18 people every day.
- One acre of trees absorbs enough carbon dioxide per year to match that emitted by driving a car 26,000 miles.
- Urban neighborhoods with mature trees can be up to 5 degrees cooler in summer heat than neighborhoods without trees.
- A one degree rise in temperature equals a 2 % increase in peak electricity consumption
- Large trees remove 60 to 70 times more pollution than small trees.
- The root system inside the floor of the forest can act as an aqua guard in purifying water from chemicals and impurities.

Keeping these issues in mind, it becomes obvious that we are causing a great harm to the long term welfare of our communities in neglecting our forest in building our power plants.as an economic asset. Forests are not only a source of timber, fuel wood, but also markedly influences local and regional climate, preserves soil from erosion, mangroves prevent flooding and trees act as stores of carbon and biodiversity. In the developing world some 75 per cent of all medicinal drugs are from forest plants.

It is surprising that IEP has not discussed the huge possibilities to reduce GHG emissions through Carbon Trading, Clean Development Mechanism, and the potential huge revenue from them. Also IEP has not discussed the relevance of the objectives of National Forest Policy or Policy on Non-conventional Energy Sources or National Water Policy to the integrated energy policy. As a planning commission document it should have taken into account all such national policies into objective account.

The inextricable link between economic development, secure energy and green environment of suitable carrying capacity should always be a primary plank in our national policies. IEP has not taken such a holistic stand.

6.4 Acid Rains

Acid rain is a term used generally to rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen or pH. It can have harmful effects on plants, aquatic animals, and infrastructure. Acid rain is caused by emissions of carbon dioxide, sulfur dioxide and nitrogen oxides which react with the water molecules in the atmosphere to produce acids. The chemicals in acid rain can cause paint to peel, corrosion of steel structures such as bridges, and erosion of stone statues. Old temples, heritage buildings/monuments, steel structures such as railway bridges etc. will be affected by acid rains.

The principal cause of acid rain is sulfur and nitrogen compounds from human sources, such as electricity generation, factories, and motor vehicles. But coal power plants are considered to be the most polluting. The sulfur and nitrogen gases can be carried hundreds of kilometers in the atmosphere before they are converted to acids and deposited. Acid rain has been shown to have adverse impacts on forests, freshwaters and soils, killing insect and aquatic life-forms as well as causing damage to buildings and having impacts on human health. The most obvious environmental effect of acid rain has been the loss of fish in acid sensitive lakes and streams (http://www.adirondackcouncil.org/acrapub.pdf).

6.5 International Obligations

IEP's recommendation to increase the installed power capacity by about 5 times, mostly through large size conventional power projects, and subsequent planning for huge additions to coal power and nuclear power capacity may be seen as a question mark on our country's ability to respect our commitment to the international community.

In the Cocoyoc declaration of 1974 at Mexico, as part of UN Conference, it is said on the purpose of development: "Our first concern is to define the whole purpose of development. This should not be to develop things but to develop man. Human beings have basic needs: food shelter, clothing, health, education. Any process of growth that does not lead to their fulfillment - or even worse, disrupts them – is travesty of the idea of development. The problem today is not one primarily of absolute physical shortage but of economic and social mal-distribution and usage." Large conventional power plants lead to the displacement of thousands of people, who because of highly insensitive rehabilitation process are most likely to become destitute. Additionally, because of high rates of pollution people living close to thermal and nuclear power plants experience severe health problems for no mistake of theirs.

Convention on Biological Diversity was signed by 156 states in 1992, the objectives of which are the conservation of various components of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisataion of genetic resources. India, which is a signatory to this convention and which also has two of the most important bio-diversity hotspots as per UN (Western Ghats and Himalayas) cannot stake claim as a diligent protector of its own bio-diversity. The large size dams are not only reducing the land based bio-diversity by drowning thick forests, but also are reducing aquatic bio-diversity by denying water and precious silt to the downstream of the dam. While a recent statement by Sri. Jairam Ramesh, Minister of Environment & Forests has indicated that almost one-third of the country's top grade coal reserve should not be available for mining as these areas are now considered to be ecologically too fragile to allow mining, it should be noted that almost all coal mines which were opened in the past and those which are going to be opened were /are below thick forests. If we continue to opt for more of coal power stations the rich bio-diversity in these forests will be destroyed.

A recent report by MoEF "Achieving 2010 Biodiversity Target: India's contributions" has copiously described the rich biodiversity in the country, the threats to it and the remedial measures. It can be safely said that without holistically reviewing the recommendation of IEP to build large conventional power plants, we, as a society, cannot take any credit for contributing to the conservation of global biodiversity. It goes without saying that we have a duty of care at least to introspect on the impact on biodiversity of huge number of large size conventional power plants proposed.

The Ramsar Convention on Wetlands[6.1], seeks commitment from signatory countries to protect the wetlands due to their huge significance to aquatic bio-diversity. These wetlands also are very important from the perspective of fresh water and fishing for those

vulnerable sections of the society living close to them. A large number of coal power plants being planned in the coastal areas of Andhra Pradesh are known to be threatening such wetlands, because of which large scale opposition to such projects are being witnessed in 2011-12.

> World Charter for Nature was adopted by consensus by UN General Assembly in 1982. It has provided some guiding principles for protecting biodiversity (Bio-diversity Impact of Large Dams, prepared for IUCN / UNEP / WCD). Some key principles so enunciated are: (i) Activities which are likely to cause irreversible damage to nature should be avoided; (ii) Activities which are likely to pose significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that the expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed; (iii) Environmental Impact Assessment should be thorough, be given sufficient time, and be carried out in an open and transparent fashion.

As per the Convention on Biological Diversity it will be a wise policy to apply Precautionary Principle and take necessary action to conserve Bio-diversity before components of it are permanently lost.

On the basis of what has been done so far, it is hard to say that our society has been diligent in practicing these principles. If not heeding to such novel principles, our society should concern itself with hard economic facts.

As per STERN REVIEW – 'The Economics of Climate Change', the Climate Change could have very serious impacts on growth and development. The costs of stabilising the climate are significant but manageable, while delay would be dangerous and much more costly. The benefits of strong, early action on climate change outweigh costs. This Review has estimated that certain scenario of Global Warming may result in poor countries like India suffering economic costs of about 20 % of its GDP, whereas the mitigation of the same now can be achieved at a cost of about 1% of present GDP. The Review also indicates that more we delay in addressing the Global Warming the higher we will have to spend in mitigation of the same in future. In this background adequate investment to minimise the Global Warming impacts of conventional power plants is considered worth the huge cost.

The international community has attached so much importance to the forests that the main outcome of the UNFCC meet at Poznan few years back was that the resolution to set in motion an international mechanism on 'Reducing Emissions from Deforestation and Forest Degradation' (REDD) was adopted. Large

conventional projects and coal mines can only reduce the all important forest cover and bring negative changes to the forest area that limit its production capacity.

A report "Bio-diversity Impacts of large dams" prepared for UNEP & IUCN, has listed a large number of such impacts. Among other things it says that about 60% of the world's river flow is regulated with serious implications on biodiversity dependent on rivers. India's contribution to this number is not small.

Keeping the letter and spirit of these requirements, and large number of national/ international reports, and conventions in proper perspective it will be no exaggeration to state that India, as a responsible member of the international community, has largely failed to implement the necessary policies to safeguard the interest of our bio-diversity, environment and weaker sections of the society by continuing to ignore the huge implications of building a large number of conventional power projects.

The fourth assessment report of IPCC shows that the emissions of the greenhouse gases that contribute to global warming must fall by 2050 by 50-85% globally compared to the emissions of the year 2000, and that global emissions must peak well before the year 2020, with a substantial decline after that, in order to limit the growth in global average temperatures to 2 degrees Celsius above pre-industrial levels. In the near term, by 2020, emissions from industrialized countries (listed in Annex I of the Kyoto Protocol) need to be reduced by 25-40% below 1990 levels, while substantial deviations from the current trend in developing countries and emerging economies will also be required. In this context it is impossible to imagine how India's total GHG emissions can be less as compared to that in Y2011, let alone that in Y2000, unless definitive measures are taken with concerted efforts to reduce the GHG emissions form the power sector.

The National Action Plan for Climate Change (NAPCC), with 8 specific missions as launched by the govt. of India, has been touted as India's positive action plan to combat the impacts of Global Warming. But the inconsistencies one can find in the past and present policies of power sector w.r.t these missions can clearly defeat the objectives of these missions. There is an urgent need to look at the power sector practices in the context of what is desired in NAPCC, and bring about the suitable corrections. It is very doubtful that the high GDP centred growth strategy as pursued by the government will be able to ensure the harmony between NAPCC and the policies/practices within power sector.

6.6 Green India Mission and National Action Plan for Climate Change

One of the 8 missions declared under National Action Plan for Climate Change (NAPCC) is Green India Mission, under which the area for afforestation is proposed to be doubled in 10 years. This

mission has a budgetary proposal of Rs. 40,000 Crores. It is difficult to visualize how the real objective behind this Mission can be realised, if a large number of additional coal mines are permitted to be opened, and huge tracts of natural forests are allowed to be drowned by dams for hydel power plants as has been the recommendation of IEP. Additional nuclear mines also will destroy natural forests. A large number of additional transmission lines will lead to felling of huge number of trees, and may lead to fragmentation of thick forests. These are all going to act against the interest of forests/green cover. Unless we address these fundamental issues, it may not be unrealistic to suggest that most of the proposed Rs. 40,000 Crores budget may not end up in optimal use to our society.

> In May 2010 MoEF released the draft Mission document on National Mission for a Green India. As per this document the three fold objectives to be achieved in next 10 years are: (a) double the area to be taken up for afforestation / eco-restoration in India: (b) Increase the GHG removals from India's forests to 6.35% of India annual total GHG emissions; and (c) enhance the resilience of forests /ecosystems.
> All these will be possible only if there is adequate containment of deforestation and degradation of the existing forests. To loose a considerable part of the rich tropical forest with very high bio-diversity value because of large size power projects and coal mining will negate the very objective of this mission.

Whereas Green India Mission aims at bringing additional land area under afforestation measures, such forest & tree cover (mostly of mono-culture varieties) can never compensate the rich bio-diversity of our natural forests which will be seriously impacted by large conventional power projects.

A substantial portion of the budget of Rs. 40,000 Crores for the Green India Mission should be used to encourage the states in Himalayas, Western and Eastern Ghats, and the central India in protecting the rich existing forest wealth, by persuading not to build hydel projects.

Reducing Emissions from Deforestation and Forest Degradation (REDD) is another initiative by UNFCCC to address Global Warming concerns, where financial incentives are made available for developing countries to protect and conserve the forest wealth. India, especially the Himalayan states, has a good case for protecting the forest wealth and the rivers by making use of this mechanism.

Whereas few missions, including Green India Mission, have been launched in recent years at huge costs to the society with the avowed goal of increasing the green cover, many policies in the power sector can be seen as continuing to act against such missions. Through an order by Ministry of Coal (no. 13011/2011-CA-I of date 27 January

2012), the earlier proposal by MoEF to classify all potential coal mining areas as "GO" OR "NO GO" areas depending on the density of forest cover, has been rescinded obviously to allow more coal mining operations to start. In this context it should be noted with great concern that with this decision by the government while the thick forest cover in the earlier proposed NO GO areas, which are known to be very good sinks for CO_2 will be destroyed, the mining of coal (and subsequent burning) will lead to massive additional GHG emissions. In all such decision/policies the state/union governments choose to remain silent on the impact on environment and people, while supporting only the so called economic development, and private business houses. It is hard to understand how such decisions can be consistent with the overall objective of Green India Mission.

6.7 Constitutional Obligations

When we look at the huge inefficiency prevailing within the electric power sector, and the plans for large addition to conventional power plants in the country with a correct perspective, the violation in letter and spirit of many provisions of various Acts of parliament and the very Constitution may become obvious. As per the sections 48 (a) and 51 (a) (g) of our Constitution it is the duty of the STATE and every citizen to make honest efforts to protect and improve our environment by protecting and improving rivers, lakes, forests and living beings. IEP may seem to have failed to accord due importance to this critical duty of care.

When we look at the recommendations of IEP from the perspective of what the conventional power plants have achieved in the past, it is almost impossible to notice the compliance of the letter and spirit of Indian Electricity Act 2003, and National Electricity Policy[6.2] as far as salient features such as efficiency, economy, responsible use of natural resources, consumer interest protection, reliable supply of electricity, protection of environment etc. are concerned.

Despite three important Acts of our parliament namely Environmental Protection Act, the Forest Conservation Act and the Wild Life Protection Act aiming to provide adequate protection of our natural wealth, including the bio-diversity, unscientific and unrestricted growth in conventional power capacity has continued to threaten the flora, fauna, rivers and environment. IEP seem to have failed to take these issues into objective consideration.

Non-compliance of many provisions of our Constitution and IE Act 2003 has been highlighted in a writ petition admitted in India's Supreme Court in 2011 (Civil Orig 6/2011; Bharat Jhunjhunwala vs Union of India). This petition has shown that the Techno-Economic Clearance accorded to hydro power projects by CEA is generally not consistent with the letter and spirit of many provisions of our Constitution and IE Act 2003, and has listed those non-compliances. Major issues raised in this petition are associated with the manner in

which CEA is handling the 'techno-economic clearance' for hydel projects.

Whereas the National Forest Policy recommends that 33% of the land mass should be covered by forests and trees for a healthy environment, our practice of continuing to divert forest lands for large power projects (and other purposes) will bring this percentage much below even the present low level of 24% in the country[6.3].

If our society continues to deem each of the proposed conventional power plant as essential and that the interest of forests/rivers/biodiversity are expendable then the provisions under various laws of the land will remain in books only.

W.r.t to power sector there is a need for the Civil Society to introspect:
As a responsible and a welfare nation, have we exhibited the necessary commitment and means of following various international obligations/ guidelines in an objective sense to adequately protect flora, fauna, rivers and environment? Are we living up to the expectations of our constitutional forefathers in protecting the legitimate rights of the vulnerable sections of our society and that of bio-diversity through the past and present policies/practices in power sector?

At a time when other primary sectors of our economy like poverty alleviation, health and education are starved of funds, must we continue to pour thousands of Crores of rupees in adding new generating capacity through conventional technology, only to end up with productive and economic usage of the so produced electricity to an extent of about 20% only, and fail to consider cheaper alternatives? Should we not consider the techno-economically viable alternatives first, which are generally associated with smaller gestation period, much lower costs, minimum or nil environmental impacts and the absence of public opposition?

Hence, while planning large projects such as dam based or coal fired or nuclear power projects, the very likely possibility of project authorities failing to fulfill their commitments and/or strong opposition by the public should be factored in, because such projects are likely to be delayed indefinitely by controversies.

As an essential part of minimising the impact of Global Warming, for which power sector is a major cause, there is a need to apply a paradigm shift in the way we look at the bio-diversity and environment.

The society can ill afford to allow the current chaotic situation to continue if we are hoping to become a welfare state. In this regard there is an urgent need to thoroughly review the past and present practices in electrical power sector, which has the

> As Dr. Vandana Shiva, a social and environmental activist says: "The ecological shift involves not seeing ourselves as outside the ecological web of life, as masters, conquerors and owners of the earths resources. It means seeing ourselves as members of the earth family, with responsibility to care for other species and life on earth in all its diversity, from the tiniest microbe to the largest mammal. It creates the imperative to live, produce and consume within ecological limits and within our share of ecological space, without encroaching on the rights of other species and other people."

potential to become the biggest polluter of our environment, and the fastest exploiter of our natural resources if they are not managed responsibly. There should be onus on the project proponent of establishing the real societal need for additional conventional projects beyond reasonable doubts. The project proponent should satisfactorily convince the public that all the other alternatives to dam based OR coal based OR nuclear based power projects have been fully explored, and that the proposed project is in the best interest of the society. It must also be mandated that all the details of project report (except those which are commercially sensitive), Costs and Benefits Analysis (CBA), and the Environmental Impact Assessment (EIA) reports should be put on public domain for adequate periods so that concerned people can study the same.

6.8 Deficiencies with institutional mechanism

An oft repeated statement amongst our communities is that while there are adequate provisions of law under various Acts of the parliament or of the states to protect the legitimate rights of people and the bio-diversity, it is the implementation which is the cause for concern. This statement is very true in the case of power sector.

Whereas the Acts and rules preceding IE Act 2003 had adequate provisions to protect the legitimate rights of people and the bio-diversity, because of the inadequate attention to the implementation of the same the environment is known to have undergone steady deterioration, and the agitations to oppose power plants increased rapidly. Despite EIA notification of 2006 there has been large number of grievances on how the environment is being treated by the project developers. The agitations by the project affected families (PAFs) have only increased against most of the power project proposals due to the poor handling in the past of the issues associated with land acquisitions and compensation.

EIAs prepared by the project developers are being challenged in the courts of law more often, and there have been frequent complaints that the public hearing under EIA notification of 2006 are poorly handled. There are incidences wherein the

environment clearances get stalled or cancelled because the public hearings were inappropriately conducted. The PAFs and the environmental activists have regularly expressed concern that many power projects get cleared in a single sitting of the Expert Advisory Committee (EAC) under MoEF, because the time available in each of such meeting may not be adequate for due diligence. The number of cases pending in Green Tribunal may indicate the inadequacy in these approval mechanisms.

Environmentalists and many sections of the Civil Society are aghast that the environmentally sensitive areas such as Western Ghats, Himalayas, Central Indian forests, wet lands, coastal areas etc. have not been treated carefully while considering environmental clearance to power project in those areas. One such recent approval was w.r.t the giant Jaitapur Nuclear Power project in Konkan area of Maharastra. They argue that this area being an important part of Western Ghats, which itself is one amongst the 18 bio-diversity hotspots in the world, should not have been considered for the project at all. They are agitated that public consultation on such a major decision was not adequate, and that the opinion of the local people has been completely ignored. They point out that the Western Ghats Expert Ecology Panel (WGEEP) under MoEF has clearly recommended against such large projects in that area.

The district collectors/deputy commissioners of the revenue district along with the state pollution control boards are required to conduct the public hearing in a fair and transparent manner according to EIA notification of 2006. But very often the allegations are heaped on these authorities that the process adopted is not diligent and transparent. In all such cases an issue of great concern is the common allegation that these authorities may be favoring the project developers by not giving adequate opportunities for the public to record their views. Whereas the project developers are given a rightful place to make their submission before Expert Advisory Committee (EAC) under MoEF, the other stake holders are not given this opportunity. There is always a possibility that the project developer presents a distorted scenario of the local geographical, environmental and social issues to obtain the environmental clearance. Since EAC rarely visits the project site, the opportunity to the other stake holders to make submission before it can address this problem to a large extent.

The role of Central Electricity Authority, which has the mandate to consider techno-economic clearance to hydel projects, is increasingly coming under focus. The Civil Society's complaint against it is that while CEA is mandated under the law to consider all the direct and indirect costs to society from hydel power projects, it is seen to be ignoring many costs such as environmental and social costs to the state and the country.

Since, under the spirit of the IE Act 2003, the best option available to the society should be adopted to meet the electricity demand, CEA is expected to consider all the options available in addition to the dam based hydro power proposal. Such a representation against the role of CEA/ MoEF is highlighted in a petition by Dr. Bharat Jhunjhunwala in the Supreme Court of India (as discussed in section 4.6).

Though the electricity regulatory commissions (ERCs) have been functioning since nearly 14 years, they are not enjoying the full confidence of the public, as evidenced by poor participation from the public. People's expectations of these regulatory bodies are much more than what has been possible so far. It appears that the unbearable pressure (from the private business houses) associated with the perceived need for large additional power capacities on such administrative ministries, regulatory bodies, pollution control boards, and other agencies has resulted in less than diligent application of the spirit of law to effectively take care of social and environmental issues. There is an urgent need to strengthen the institutional mechanism in order to address the social and environmental issues effectively.

Reference material

6.1: "Ramsar Convention on Wetlands": www.ramsar.org

6.2: "National Electricity Policy": http://www.powermin.nic.in/whats_new/national_electricity_policy.htm

6.3: "National Forest Policy": moef.nic.in/divisions/fp/nfp.htm

6.4: "National Action Plan on Climate Change (NAPCC)" : http://www.c2es.org/international/country-policies/india-climate-plan-summary/06-2008

Other reference material

1. The websites of UNFCC and IPCC: http://www.ipcc.ch/
2. 'The Economics of Climate Change'; www.sciencemag.org VOL 317 13 JULY 2007
3. MoEF : http://moef.nic.in/index.php
4. "The Anatomy of Silent Crisis": Global Humanitarian Forum, Geneva
5. "Global Green New Deal": UNEP: http://www.unep.org/
6. "Ramsar Convention on Wetlands": www.ramsar.org
7. "Global Warming and India: Lopsided priorities": http://www.indiaenvironmentportal.org.in/news/global-warming-and-india-lopsided-priorities
8. "India's low carbon strategies: are they good enough?": http://www.indiaenvironmentportal.org.in/reports-documents/india%E2%80%99s-low-carbon-strategies-are-they-good-enough

Chapter 7

Role of renewables in future

- moving towards sustainable life-style

Key terms: new and renewable energy sources, capital cost, utilisation factor, solar power, bio-mass, bio-fuel, wind turbines,

Chapter Summary

On the basis of an objective consideration of many national and international reports on Indian power sector, it appears safe to state that the future of our country entirely depends on how effectively our society will be able to harness the huge renewable energy potential within the country. At the international level there is increasing level of confidence and advocacy for deploying renewable energy sources. An integrated energy resource management approach, with a carefully designed combination of centralized and decentralised renewable energy sources, is absolutely needed to avail energy security. The renewable energy sources in distributed mode alone can provide the energy security to our rural population, and not the dependence on external resources such as coal, petroleum and gas as recommended by IEP.

A major issue with IEP is that it has not indicated a high level of confidence in the ability of the new and renewable energy source to play a major role in meeting the energy demand, though it recognizes the need to provide higher importance to develop the same. This is in sharp contrast with many international reports (some of them have been published after 2006), which repose very high level confidence to meet the growing electricity demand. The high capital cost and inadequate investment in R&D are quoted as major constraints by IEP. The potential for on-shore wind power is projected as between 45,000 MW and 65,000 MW. Because of low level of utilisation factor of wind mills so far, IEP estimates that the contribution to energy would be relatively small. Much better level of confidence is shown by IEP in solar power, bio-mass and bio-fuel potential.

7.1 Potential for renewable energy sources in India

The importance attached to the renewable energy sources by the Union government may be indicated by the creation of a separate

ministry for it: Ministry of New & Renewable Energy (MNRE); probably first in the world. However, the total budgetary support for the renewable energy sources since independence can be said to be negligible as compared to that given to conventional energy sources. This is despite various reports indicating the vast potential in and high relevance of renewable energy sources.

The total potential of solar PV and Solar Thermal in the country is estimated to be about 2,400 Million Tons of Oil Equivalent (Mtoe) per year as per IEP. This is in stark comparison to the estimated total primary commercial energy requirement of the country in 2031-32 of about 1,700 Mtoe. What it basically means is that if enough emphasis is given, solar power alone has enough potential to meet all our energy demands for many decades to come.

Whereas as per IEP projection the demand for electricity generation by 2031-32 is about 3,600 Billion kWH/year, solar energy potential in the country is estimated to be about 5,000 trillion kWH/year. The true potential of various modes of solar power is so great that even if we can harness about 0.1% of it, all the energy needs of the country can be met.

Table 15: N&RE potential in India

	Potential (Grid interactive power only)
1. Wind energy	50,000 MW (Onshore only) / (100,000 MW as per WISE) / 748,000 to 976,000 MW as per a recent study in 2011)
2. Small hydro	15,000 MW
3. Solar	Over 5,000 trillion kWH/year Potential (estimated to be many times more than the total energy needs of the country) / (200,000 MW of CSP as per WISE)
4. Bio-mass	> 50,000 MW
5. Ocean based Energy	With about 7,000 kM of coastal line potential should be huge, but no estimates available
6. Geo-thermal	Estimated to be considerable

(Primary Source: MNRE, Govt. of India)

According to the World Institute of Sustainable Energy (WISE), the grid connected renewable energy potential of the country is much more than that projected by MNRE.

- Wind Energy – 100,000 MW;
- CSP based solar power generation – 200,000 MW;
- Solar PV based power generation – 200,000 MW (here the available land space may not be a problem, if we also consider all the rooftops available).

> As per a recent study "Reassessing Wind Potential Estimates for India: Economic and Policy Implications" (by Lawrence Berkeley National Laboratory, Itron Inc and Black and Veatch, Sept 2011), the on-shore wind potential in India at three different hub-heights and under two sensitivity scenarios – one with no farmland included, the other with all farmland included. Under the "no farmland included" case, the total wind potential in India with a minimum capacity factor of 20 percent ranges from 748 GW at 80m hub-height to 976 GW at 120m hub height.
> Under the CERC norms, approximately 200 GW of wind potential is available at a levelised cost of Rs. 5/kWh or less – at all three hub-heights and both farmland inclusion sensitivity cases. At120m hub-height (minimum capacity factor of 22 percent) and the "all farmland included" scenario, approximately 1,000 GW of wind potential is available at Rs. 6/kWh or less. At least18 GW of wind energy potential can be developed today at less than Rs. 4/kWh at all three hub heights and under both farmland inclusion scenarios.[7.1]

IEP has basically looked at the grid interactive potential of renewable energy sources. These sources, especially solar energy, have very huge potential, if distributed type potential such as small size roof top or community based renewable energy plants, are considered. Because of the huge losses involved in Transmission and Distribution of generated electricity, all the attendant problems such as theft, organizational issues, huge capital expenditure to the state, technical problems such as voltage stability etc. ,which are salient features of a grid interactive energy sources, distributed renewable energy sources are best suited for rural electrification and for small loads such as lighting, other domestic appliances, small pumping needs etc. The potential of the new & renewable energy sources can almost be termed as unlimited when they are effectively used as distributed energy sources.

7.2 Distributed type of renewable energy sources

IEP has failed to objectively view the acute crises the country is facing due to inefficiency in the present grid based centralized power plants system, and the obvious benefits of distributed renewable energy sources. The main advantages of distributed renewable energy sources as compared to the present grid based system of large conventional power plants can be listed as:

- Will greatly reduce the effective demand on the grid based power supply system; will drastically reduce the T&D losses; vastly improve the power supply to those consumers essentially needing the grid supply; much better voltage profile; leads to much reduced spending on grid management;
- Will drastically reduce the need for fossil fuel based, dam based and nuclear power stations and the associated transmission & distribution network; reduced complexity in system operation;

- Will assist in drastically reducing the GHG emissions and other pollutants;
- Will provide a sustainable, environmental and people friendly energy supply model;
- Will accelerate the rural electrification due to shorter gestation period of individual projects;
- Will lead to increase in rural employment opportunities, and hence assists in minimizing urban migration;
- Reduces the pressure on natural resources such as land and water;
- Their impact on the environment will be minimal, and they are inexhaustible;
- Lead to much reduced growth in demand for grid electricity;
- Avoided costs of recurring fuel expenditure and of peak load power stations;
- Absence of the need for people's displacement.

While harnessing the small hydro potential adequate care is required to minimise the impact on bio-diversity and local environment. Similarly, in the case of bio-energy resources, all possible care should be taken to protect the food security in the country, by not diverting any useful land to grow bio-fuels.

IEP has failed to acknowledge these critically important and recurring benefits, and has come to the unfortunate conclusion that due to large areas of land required and huge capital expenditure required for Grid interactive renewable energy plants, their contribution to electricity requirements in 2031-32 cannot be high. Whereas the land required for Grid interactive type renewable energy plants will be large, the same problem gets almost completely eliminated when we focus on small size roof top or community based renewable energy plants.

Roof top or community based renewable energy plants, such as solar water heaters and solar PV panels are already being used in our country. In effectively harnessing the solar energy in our country the roof top surface available is enormous: individual houses, educational institutions, commercial establishments, hostels and hotels, factories, storage houses, office buildings etc. Similarly, the potential for small size wind mills and a hybrid of wind mill and solar PV on roof tops is not inconsiderable. Community based systems such as bio-mass, wind mill or solar systems either individually or a hybrid of two or more can entirely solve the energy needs of rural communities. For inexplicable reasons IEP has not even considered this huge potential. Such small size renewable energy plants have the potential to meet almost all the smaller electricity loads in the country, and can reduce the net demand on the grid by a considerable margin. An

appropriate feed-in-tariff to effectively harness the excess electricity generated by such distributed renewable energy plants will probably eliminate the need for most of the proposed conventional power plants. IEP has failed to appreciate this enormous potential.

7.3 Plunging costs of Renewable energy sources

Two most common questions raised in case of new and renewable energy sources are that they are not firm power and that their comparable cost with conventional energy sources is high. The reality behind these issues is as follows:

- Many applications like lighting loads, water pumping for domestic and smaller agricultural needs, water heating for bathing etc. are not heavy and do not require 24 hours supply. Lighting loads can be adequately met by backup battery systems when the main sources like solar or wind energy is not available. These battery systems can be charged by the respective energy sources. Applications like solar water heating with adequate capacity water storage facility need no battery backups. Solar water pumps for lighter agricultural or domestic loads are ideal for usage during the sunlight hours. These can also function much more reliably in conjunction with other renewable energy source of bio-mass and wind turbines where feasible. These sources are already in use in the country.
- There have been advances in solar thermal technology, wherein molten salts are being used to capture the abundant solar heat during the day time to use the same during night times to generate steam for the associated steam turbines. This technology is reported to being increasingly used in USA to take care of the absence of sunlight during nights. When the solar PV installations are deployed in conjunction with such technologies, the issue of 'infirm' power can largely be resolved. Additionally, when various renewable energy sources such as wind and bio-energy are used in conjunction with solar PV panels or solar CSP, it is credible to assume that the issues with 'infirm power' can be resolved satisfactorily.
- Though it is true that the initial cost of these new and renewable energy sources was seen as high in 2006 (by IEP) as compared to the conventional energy sources, it is only because the society had already invested very heavily for the infrastructure required for the development of the latter. Subsequently the capital cost of solar and wind power installations have come down considerably. Also, the real cost of recurring fuel needs in case of coal, diesel, natural gas or nuclear fuel will be avoided in the case of renewable energy sources. Whereas both the capital cost and energy cost from the conventional energy sources is increasing all the time, the same is opposite in case of new and renewable energy sources. Already the

cost of new and renewable energy sources has come down by large margins in the last decade. In addition, if we take the environmental costs, social costs, health costs, Global Warming mitigation costs, T&D losses and the large infrastructure required for the grid quality conventional energy sources, the distributed energy generation based on new and renewable energy sources will be much cheaper.

As mentioned earlier, the total budgetary spending on new & renewable energy sources by the union govt. is a small fraction of that on nuclear power.

- The benefits of the new and renewable energy sources will be optimum when we consider them as distributed generation sources. An objective analysis of all the societal costs and real benefits over the duration of the known life cycle of conventional energy sources as compared to that of new and renewable energy sources will reveal that the renewable energy sources are of much higher benefits in almost every situation.

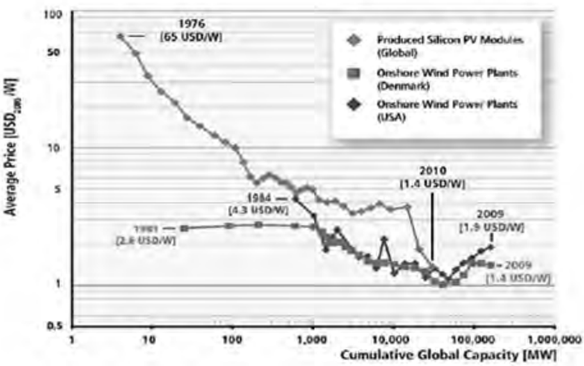
India's own example indicates how fast the solar power costs are coming down. As a part of its Solar Mission the govt. had invited tenders from developers to supply solar power to the grid. The Hindu Business Line news report ("Solar power prices inching towards common man's reach" of 2 Dec, 2011) has mentioned that whereas the lowest tariff in Batch I in 2010 was Rs 10.90/per unit, the same has become Rs 7.49/per unit in Batch of 2011. Solairedirect, the French company that made history by offering to sell solar power at as low as Rs 7.49 a unit in this bid, was reported as saying that it wanted to "send out a message" that solar power need not depend on subsidies and incentives to come within the reach of the common man.

Author's own experience of fast dipping prices of solar substantiates his advocacy for critical role for renewables. In 2009 he paid about Rs. 80,000 for a solar PV system consisting 2*50 Watts panels, 120 VA batteries, 500 VA inverter, wiring and commissioning. In 2011, the price of 4*50 Watts panel system was reported to have come down to about Rs. 35,000. Author's experience with the roof top solar PV system has been satisfactory as it has largely provided good backup for the unreliable supply prevailing in his village. The solution for many of India's power sector ills can be seen in such solar PV systems. With suitable policy interventions such systems can be made affordable to most residences.

A Sierra Club report of May 2011 has provided the following chart indicating how the capital cost of wind and solar power technologies have come down since 1976.

This chart was a part of "Sierra Club India Environment Post 5-23-11: Mission Critical: Focusing on What Energy Costs Today". The report says: "A disruptive shift in the world energy economy has rendered the commonly accepted axiom that renewable energy is expensive and fossil fuels are cheap oversimplified and outdated. From soaring coal and oil prices, to rock bottom solar module prices, the signs are everywhere that what we believe we know about energy costs today requires immediate revision. Most importantly, this shift marks the end of an era of abundantly available cheap hydrocarbons, and the ushering in of a new era of abundant, cheap, and reliable renewable energy."

Referring to IPCC's 'special report on renewable energy', Sierra Club goes on to add: "One of the short comings of the IPCC analysis is the very narrow price band it displays for conventional



energy. The high end of the IPCC estimate shows non renewable resources coming in at 10 cents/kwh. Yet we know that new coal plants in the United States can be as high as 13.3 cents/kwh while new gas plants can be as high as 16.3 cents/kwh. These costs don't even include modern pollution control equipment required to minimize a laundry list of local air pollutants."

With adequate policy intervention the costs of renewables will go down further, whereas the costs of conventional power sources can only go up. Though IEP has acknowledged that the exhaustible conventional power sources cannot be relied on for long, the new & renewable energy sources have not been given the due recognition. In this regard one can say IEP has failed to recommend a suitable long energy term policy for the country.

7.4 International advocacy for higher role for renewable energy sources

There has been a spate of international reports in recent years expressing credible confidence in and advocating for a definitive

shift towards renewable energy sources. Many of these reports have been published since 2006, and hence it can be said that IEP did not have the benefit of these reports.

> **"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that." - Thomas Edison in conversation with Henry Ford, 1931**

International Energy Agency (IEA) has recently released it's estimation that by 2050 about 22% of the global energy (totaling various forms of commercial energy) can be met by solar power alone.

A Greenpeace report titled "energy {R}evolution, A SUSTAINABLE INDIA ENERGY OUTLOOK",[7.2], with international authorship has dealt with the Indian energy scenario in good amount of detail, and has come up with a credible set of solutions. An important point highlighted in this report is the huge potential available in reducing the demand for energy without adversely affecting the legitimate needs of our society. This projection has discussed the feasibility in reduction of about 38% in demand by 2050 as compared to the reference scenario of International Energy Agency (IEA). The study report is confident that by adopting suitable measures "by 2030 about 35% of India's electricity could come from renewable energies" AND "by 2050, 54% of primary energy demand can be covered by renewable energy sources". The report states: "A more radical scenario - which takes the advanced projections of renewables industry into account - could even phase out coal by 2050. Dangerous Climate Change might force us to accelerate the development of renewables faster."

A survey report "Access to Energy for the Poor: The Clean Energy Option" by OilChange International, ActionAid and Vasudha Foundation has highlighted the need of renewable energy sources in India. This report highlights the following facts regarding clean energy access:

- Fossil fuels and other conventional energy sources have negative externalities, including pollution and public health impacts, and fossil fuel extraction has been shown to correlate with higher levels of poverty, child mortality and malnutrition, civil war, corruption, authoritarian governance, and gender inequality.
- Clean, decentralized renewable energy is often the most appropriate means of providing holistic energy services in rural areas that support both economic and social development, and these decentralized energy services can be more reliable than conventional grid based energy for providing energy access.

- Clean energy for access is economically feasible in comparison to conventional technologies, particularly for areas at a distance from the grid. The cost of decentralized, renewable energy can be less expensive than conventional, grid-powered electricity for areas at a distance from the grid.
- Improving end-use energy efficiency can be one of the most cost effective ways of providing energy services.

In another article titled "A path to Sustainable energy by 2030" [7.3], in Scientific American in November 2009, the authors have illustrated a plan as to how solar, water and wind technologies can provide 100 percent of the world's energy, eliminating all fossil fuels and nuclear power. It has referred to a 2009 Stanford University study which ranked energy systems according to their impacts on global warming, pollution, water supply, land use, wildlife and other concerns. The very best options were wind, solar, geothermal, tidal and hydroelectric power— all of which are driven by wind, water or sunlight. It was found in this analysis that the nuclear power, coal with carbon capture, and ethanol were all poorer options, as were oil and natural gas. Such a plan calls for millions of wind turbines, water machines and solar installations. The report says that though the numbers are large, the scale is not an insurmountable hurdle; society has achieved massive transformations before. During World War II, the U.S. retooled automobile factories to produce 300,000 aircraft, and other countries produced 486,000 more. In 1956 the U.S. began building the Interstate Highway System, which after 35 years extended for 47,000 miles, changing commerce and society. What is needed is concerted efforts across the globe.

The IPCC report 'Special Report Renewable Energy Sources (SRREN)', which was released in May 2011[7.4], has projected a very critical role for renewable energy sources, and hence deserves greater attention for enabling a paradigm shift in our energy policy to eliminate the chances of Nuclear Accidents. This report has projected that the renewable energy could account for almost 80% of the world's energy supply within four decades. The report has said that if the full range of renewable technologies were deployed, the world could keep greenhouse gas concentrations to less than 450 parts per million, the level scientists have predicted will be the limit of safety beyond which climate change becomes catastrophic and irreversible. Ramon Pichs, co-chair of one of the key IPCC working groups, has said: "The report shows that it is not the availability of [renewable] resources but the public policies that will either expand or constrain renewable energy development over the coming decades. Developing countries have an important stake in the future – this is where most of the 1.4 billion people without access to electricity live yet also where some

of the best conditions exist for renewable energy deployment." Sven Teske, renewable energy director at Greenpeace International, and a lead author of the report, has said: "The IPCC report shows overwhelming scientific evidence that renewable energy can also meet the growing demand of developing countries, where over 2 billion people lack access to basic energy services and can do so at a more cost-competitive and faster rate than conventional energy sources. Governments have to kick start the energy revolution by implementing renewable energy laws across the globe."

Earth Policy Institute, Washington had looked at ways and means of reducing the CO_2 emissions to contain Global Warming. After a detailed examination of the energy resources and the existing technologies available throughout the world, this study has projected the feasibility of drastic reduction between 2006 and 2020 of the conventional electricity sources such as coal based, dam based and nuclear based technologies[7.5]. This report highlights the fact that as per the study by International Energy Agency the demand for electricity by 2020 can be reduced below the level of 2006 by ramping up energy efficiency alone. It is also important to note that Earth Policy Institute has come to the conclusion that keeping in view the huge costs involved in disposing nuclear waste, decommissioning the worn out plants, insuring reactors against catastrophic failures building nuclear plants in a competitive electricity market is not simply economical. This plan called as “Plan B energy economy of 2020” may see 90% drop in fossil fuel-generated electricity and five fold increase in renewably generated electricity. This report recognises the need for massive and rapid mobilisation of resources to achieve the goal, but considers it necessary and feasible to view it as a war time emergency.

“Towards a Green Economy – Pathways to Sustainable Development” is an UNEP document advocating wise investment in renewable energy[7.6]. Its main findings are:

1. Investments in renewable energy have grown considerably with major emerging economies taking the lead.
2. Renewable energy can make a major contribution to the twin challenges of responding to a growing global demand for energy services, while reducing the negative impacts associated with current production and use.
3. Renewable energy can help enhance energy security at global, national and local levels.
4. Renewable energy can play an important role in a comprehensive global strategy to eliminate energy poverty.
5. The cost of renewable energy is increasingly competitive with that derived from fossil fuels.

6. Renewable energy services would be even more competitive if the negative externalities associated with fossil fuel technologies were taken into account.
7. Substantially increasing investments in renewable energy can be part of an integrated strategy to green the path of global economic development.
8. A shift to renewable energy sources brings many new employment opportunities, but not without transitional challenges.
9. Policy support will need to be expanded considerably to promote accelerated investment in renewable energy.
10. Government policy to support increased investment in renewable energy needs to be carefully designed in an integrated manner; there is no one-size-fits-all approach.

Participating in the fifth World Future Energy Summit (WFES) 2012, in Abu Dhabi, United Arab Emirates (UAE), on 16th January 2012, State Secretary, Germany, is reported to have stated that Germany aims to reduce its greenhouse gas emissions by 80% to 90% from 1990 levels by 2050, while simultaneously transforming its energy supply system to increase renewable energy generation to 80% by 2050.

A report from ORF Energy News Monitor (Volume VIII, Issue 31 of 11-17 Jan 2012) refers to two news items:

Global Solar capacity rose 54 pc to 28 GW

"January 13, 2012. New solar capacity around the world increased 54 percent to about 28 gigawatts last year driven by record installations in Germany and Italy. Photovoltaic installations rose to between 26.5 and 29.4 gigawatts last year, compared with 18.2 gigawatts during 2010. Solar installations grew around the world, driven by crashing panel prices. New spending on solar energy jumped 36 percent to $136.6 billion in 2011, outpacing the $74.9 billion put into wind power, and represented almost half of all renewable energy investment worldwide last year. Those figures also include solar thermal facilities, which use mirrors to heat fluid that turns turbines."

Clean-energy investment rises to $260 bn

January 12, 2012. Renewable energy investment rose 5 percent to a record $260 billion driven by a surge in solar developments and increased spending in the U.S. New spending on solar energy jumped 36 percent to $136.6 billion in 2011, outpacing the $74.9 billion put into wind power. Spending in the U.S. rose by a third to $55.9 billion, surpassing the 1 percent gain in China to $47.4 billion.

It is both significant and heart warming that a country like Germany, being a non-tropical country and hence with less potential for renewable energy, has such a huge confidence level in renewable energy sources. In this regard tropical countries like

India, with huge potential for renewable energy, have to learn from Germany. The increasing level of confidence, the plunging prices, ever increasing investment levels, and the sense of inevitability w.r.t renewable energy sources worldwide should persuade our society to shed all inhibitions on this sector and resolutely move in that direction.

A recent report published by the National Renewable Energy Laboratory (NREL), US, Department of Energy, "the Renewable Electricity Futures Study (RE Futures)", says: "Renewable electricity generation from technologies that are commercially available today, in combination with a more flexible electric system, is more than adequate to supply 80% of total U.S. electricity generation in 2050 while meeting electricity demand on an hourly basis in every region of the country. The abundance and diversity of U.S. renewable energy resources can support multiple combinations of renewable technologies that result in deep reductions in electric sector greenhouse gas emissions and water use. The direct incremental cost associated with high renewable generation is comparable to published cost estimates of other clean energy scenarios. Improvement in the cost and performance of renewable technologies is the most impactful lever for reducing this incremental cost."

This is a remarkable endorsement for what renewable energy sources are capable of. It adds to a strong ground for effective integration of renewables, in view of the concerns about intermittency and storage for wind and solar power. The NREL report also has said that about 50 percent of electricity could come from "variable renewable generation" (such as wind and photovoltaics) without any gaps in supply. In view of this highly credible report, India, being a tropical country with lot more potential for renewable energy sources, should have no hesitation to move resolutely forward to get most of its electricity from renewable energy sources by 2040-50.

7.5 True relevance of solar power in Indian context: land requirement need not be a constraint

Being a tropical country sun light and the potential for solar energy in India is practically unlimited, if we can harness it properly. As mentioned in Table 15, the solar potential in the country is estimated to be over 5,000 trillion kWH/year, which is known to be many hundred times more than the total energy needs (not just of electricity demand) of the country. As mentioned in earlier sections, solar potential need not have any limit if it is deployed in distributed mode. IEP mentions that the land area available to install MW size solar PV (SPV) systems OR solar Concentrated Solar Power (CSP) system will be a limiting factor. But IEP has failed to consider the

enormous potential in harnessing the roof top surfaces to install Solar PV (SPV) systems. The total roof top surface area suitable for installing the Solar PV systems in residences, educational installations, industrial and commercial premises, offices, hotels, theatres, ware houses, bus & railways stations, resorts etc. can be so huge that millions of MW of solar PV capacity can be achieved at no additional demand for land or water.

An illustration:
Of the 30 Crore households expected by 2032, 10 Crore houses could be assumed to be strong enough to support SPV systems. Assuming an average of 1,000 Sq. ft of roof surface area for each of these houses, the total potential for installing SPV systems on this surface can be about 1,000,000 MW @ 1 kW per 100 Sq. ft of roof surface. If even 10% of roof top surfaces in each of the other categories of building are considered for this purpose, the potential is enormous; running to millions of MW.

A highly relevant consideration in such roof top solar power concept in Indian context is that it can meet most of the loads locally such as domestic, agricultural, and illumination needs. This scenario will drastically reduce the effective load on the integrated grid, and minimize the T&D losses (which is about 25% at present), and AT&C losses (which is about 35% at present). Since the demands for electricity are met by local sources in such a scenario, the unnecessary need for electrical power coming from distant generating sources such as centrally located coal/hydro/nuclear power plants, which may be few hundred kM away, will be avoided. This situation will lead to multiple benefits: (i) T&D losses will be greatly reduced; (ii) the chronic issue of low voltage can be satisfactorily addressed without the need for large investment for voltage management methods at sub-station levels; (iii) since the ownership of the electricity generating sources gets transferred to locals, the issues of energy theft and non-realisation of energy revenues can be satisfactorily resolved; (iv) huge employment opportunities in rural areas, and hence reduction in urbanisation.

Even if all these buildings use only a part of the roof top surface area available to them, and function independently the amount solar power capacity can be huge, and will drastically reduce the effective demand on the integrated grid. Those SPV installations, which produce excess electricity, can export so produced electricity to the grid, and get good revenue. Such a mechanism, called 'feed-in-tariff mechanism' is already in vogue in many countries, and can revolutionise the electricity scenario in India, if implemented wisely.

Solar PV systems OR solar Concentrated Solar Power (CSP) system, when carefully designed and implemented in conjunction with

each other and/or with other community based renewable energy sources such as bio-energy system or wind turbines, has the potential to transform the rural energy scenario from a poor status as of now to satisfactory by 2032.

DC home lighting systems with different capacities (with 20 - 40 Watt SPV, 5-10 A Charge controller, 25 - 60 AH battery, 3 - 5 lights along with wiring) can be obtained for Rs. 12,000 to Rs. 26,000 in Karnataka. Such a system can meet the basic lighting requirements of rural houses. The un-electrified houses in the country, instead of waiting indefinitely for grid electricity should be able to get the required electricity services from such roof top SPV systems. When procured in sizeable numbers such systems can come at about Rs.10,000 per system. The state and union governments should consider such distributed type options seriously for electrifying villages than through large size conventional power plants. The cost of extending the grid supply to such villages will be much higher compared to such individual systems, while all the vexatious issues associated with grid supply and the conventional power plants will be eliminated through such distributed type options.

7.6 Practical examples of application of distributed renewable energy sources

A Greenpeace report of 2010 "Taking Charge" has shown ten case studies on the application of small-scale, decentralised renewable energy systems in India in 2010 [7.7].

"Taking Charge" by Greenpeace India, 2010:
"Taking Charge is a selection of case studies of small-scale, decentralised renewable energy systems in India in 2010. Each has two parts: the main story, which captures some of the remarkable human and social elements that have shaped these
pioneering projects, and a quick-glance section, which provides an easy reference for the more technical aspects.
The strength of these stories lies in their diversity. One is a diversity of the context in which they are based, including the geography of the place, and its social fabric. From semi-nomadic pastoral tribes in the Himalaya, to caste based politics in the deserts of Rajasthan, to church-lead community action in the hills of Kerala, renewable energy is seen being applied to the problem of energy access in a variety of contexts. Another is the diversity of solutions applied. Each of these renewable energy projects has worked because they are tailored to fit the local needs and conditions. In Bihar, a company is providing electricity to over 100,000 people using the only waste product in the villages: rice husk. In New Town Kolkata, a housing project with grid-interactive photovoltaic technology has been built, ready for the next wave of urban development. Bankers are travelling to the most remote areas of Karnataka to issue loans to farmers to purchase tiny hydro systems for their homes. Perhaps most interesting is the diversity of energy governance that these

stories demonstrate, and the economic models that they have developed. In Delhi, a hospital is saving up to sixty per cent on its water heating bills from an enterprising company that has set up shop on its roof. Across Karnataka, a company is turning profit by providing solar services to people who were previously considered unbankable. In Tamil Nadu, a Panchayat is investing in wind energy to provide better public services for its citizens. And near the Andhra Pradesh border in Karnataka, an NGO, in partnership with a community organisation of 40,000 member families, has built 5,500 biogas units across 339 villages and is monitoring their usage daily."

The report is a documentation of 10 successful case studies from across the country on how communities, civil society and individuals have used decentralised renewable energy to energise and empower their lives. There have been many other such practical examples of successful implementation of distributed renewable energy sources for electrification of remote villages being reported in the media. It is evident that without such initiatives these villages would have remained without electricity indefinitely. Bihar is reported to be banking on distributed renewable energy sources to electrify its villages.

World Institute of Sustainable Energy, has prepared a power supply map depending largely on local RE sources for the state of Bihar, which is facing serious problems of electricity production capacity due to the carving out of Jharkand as a separate state. ("Renewable Energy Potential Assessment and Renewable Energy Action Plan for Bihar; Final Report MAY 2011").

7.7 The need for a rational approach

What is urgently needed for our resource constrained society is a careful choice of the most suitable energy option for a given category of consumers and in a given geographical area. It is already acknowledged at various levels of administration that a grid based energy system with large conventional power plants at the centre of focus cannot meet the energy requirements of remote villages satisfactorily. A small residential load in a remote place in Bihar need not wait for grid quality power from a giant thermal power plant in West Bengal; OR a 3 HP pump set for drinking water needs of a village in Rajasthan need not seek power from nuclear power park in Gujarath; OR few street lights in a village in the foot hills of Uttarakhand need not ask for power from the large Tehri hydel project. Most of such small and remote loads throughout the country can be and must be supplied reliably and economically with renewable energy sources locally. If a majority of such small loads can be shifted to locally controlled renewable energy sources a considerable amount of power from the grid will be released, which in turn can be supplied to large loads such as factories and

electric traction in urban areas. Such an approach will drastically reduce the need for conventional power plants. A holistic and objective outlook is needed in this regard.

In USA, where the people are very sensitive to any increase in the delivered price of energy/electricity, increasing number of states are going for a considerable share in renewable energy. Twenty-nine states and the District of Columbia have laws that require utilities to purchase a percentage of their power from renewable sources, known as 'renewable portfolio standards'. An additional nine states have voluntary renewable energy goals. States are also beginning to take the health benefits, associated with clean energy, into consideration when planning their electricity resource mix. For example, Delaware Power's 2010 Integrated Resource Plan estimated that the health benefits of renewable energy were worth $1.8 to $4.3 billion to Delaware over the next ten years. It is being increasingly recognized that renewable energy offers a stability of price and several environmental benefits such as clean air, reducing hazardous waste and water use.

There are concerns that the renewable energy systems (such as SPV systems, CSP system, bio-energy system or wind turbines) are also linked with some social-environmental issues such as material requirement for the large number of PV panels and their environmental impacts; environmental impacts of wind turbines; food-security threat and loss of bio-mass for the soil from bio-energy sources etc. In this regard it can be said that these issues are not insurmountable, and can be reduced to a large extent even though they have much lower socio-environmental foot print than the conventional energy sources. With strong conviction of the need for renewable energy sources, and their distinct advantages over conventional energy sources, these issues can be and must be resolved satisfactorily.

A good combination of increasing amounts of renewable energy sources in distributed mode, and decreasing number of conventional power plants should be able to meet our electricity demand in the short term; while the existing conventional power plants should be planned to be completely retired when they reach their safe/economic life.

A discussion on renewable energy sources would be incomplete without mentioning some of the measures taken by the union government in that regard. The creation of a ministry for it (MNRE), IREDA, Solar missions under NAPCC etc. are all welcome signs. Renewable Energy Certificate (REC) mechanism has been

successfully introduced at the national level and is being traded since March 2011. This is expected to provide a great fillip to investment in Renewable Energy capacity addition. Jawaharlal Nehru National Solar Mission, targets setting up a generation capacity of 20,000 MW by 2022.

However, much more concerted efforts are needed in order to make the renewable energy sources as the fundamental plank of our energy policy by 2032, and the only source of electrical power in the long term. Adequate investments in R&D, and implementation of many initiatives taken by USA, Spain and Germany etc. should be considered on a war footing. There is a great opportunity for the country to adopt a technological jump (from the unsatisfactory power supply scenario) to safe and reliable supply of power through renewables, than passing through the painful stage of long term commitment to conventional energy sources, as happened to the industrialised countries.

7.8 Renewable Energy Certificates (REC)

The Electricity Act, 2003, the policies framed under the Act, as also the National Action Plan on Climate Change (NAPCC) provide for a roadmap for increasing the share of renewable in the total generation capacity in the country. Whereas Renewable Energy (RE) sources are not evenly spread across different parts of the country, there are States (like Rajasthan and Tamil Nadu) where there is very high potential of RE sources. In such States there are avenues for harnessing the RE potential beyond the Renewable Purchase Obligation (RPO) level fixed by the State Electricity Regulatory Commissions (SERC). However, the high cost of generation from RE sources may discourage the local distribution licensees from purchasing RE generation beyond the RPO level mandated by the State Commission.

The concept of Renewable Energy Certificates (REC) seeks to address the mismatch between availability of RE sources and the requirement of the obligated entities to meet their RPO. It is also expected to encourage the RE capacity addition in the States where there is potential for RE generation as the REC framework seeks to create a national level market for such generators to recover their cost.

Central Electricity Regulatory Commission (CERC) has notified Regulation on Renewable Energy Certificate (REC) in fulfillment of its mandate to promote renewable sources of energy and development of market in electricity. The framework of REC is expected to give the much needed push to RE capacity addition in the country[7.8].

Reference material

7.1: "Reassessing Wind Potential Estimates for India: Economic and Policy Implications" (by Lawrence Berkeley National Laboratory, Itron Inc and Black and Veatch, Sept 2011)
7.2: "energy {R}evolution, A SUSTAINABLE INDIA ENERGY OUTLOOK" : Greenpeace International: www.energyblueprint.info/
7.3: "A path to Sustainable energy by 2030", Scientific American, November 2009
7.4: 'Special Report Renewable Energy Sources (SRREN)', IPCC, May 2011; http://srren.ipcc-wg3.de/
7.5: "Plan B energy economy of 2020"; Earth Policy Institute, Washington
7.6: "Towards a Green Economy – Pathways to Sustainable Development"; UNEP, http://unep.org/greeneconomy/Portals/88/documents/ger/6.0_RenewableEnergy.pdf
7.7: "Taking Charge"; GreenPeace India: WWW.greenpeaceindia.org
7.8: Renewable Energy Certificate Registry of India: https://www.recregistryindia.in/

Other References

Renewable Energy Standards: If It Ain't Broke, Don't Fix It http://thinkprogress.org/romm/2012/01/17/404979/renewable-energy-standards-2/
"IREDA": http://ireda.gov.in/
"Reassessing Wind Potential Estimates for India: Economic and Policy Implications" : Lawrence Berkeley National Laboratory, Itron Inc, Black and Veatch.
"Deploying renewable energy to protect us from nuclear accidents" : http://www.indiaenvironmentportal.org.in/reports-documents/deploying-renewable-energy-protect-us-nuclear-accidents
"Ministry for New and Renewable Energy": http://www.mnre.gov.in/

Chapter 8

Other Issues of concern to society in Power sector

Key terms: energy security, import of fossil fuels, rural communities; food security, energy plantations, bio-fuels, bio-energy

Chapter Summary

Heavy dependence on imported fuels cannot be counted upon to get energy security; Energy Plantations should be carefully managed so as not to impact the food security; a definitive target year to reach peak use of fossil fuels needs early determination; IEP recommendation for creating coastal infrastructure for import and use of coal should be carefully reviewed; focus should not be only on centralized energy infrastructure.

Some of the other major issues of concern in IEP, as far as the power sector, are as follows:

8.1 Heavy dependence on imported fuels and energy security

IEP has clearly acknowledged the imminent limit to fossil fuels, including Uranium, in our country. It has discussed in length the need to import coal, petroleum products and nuclear fuels to have a total generating capacity of 778,000 MW by 2031-32. It even suggests that hydel power itself can be imported from Nepal and Bhutan. It has also referred to securing interest in oil, gas and coal fields abroad.

If our country is to depend so much on import of fuels, energy and technology, the energy security cannot be assured. The political uncertainty in supplier countries, disruption to supply lines such as ocean routes due to war or natural calamities, price volatilities, terror threats etc. cannot provide any reasonable degree of confidence to rely upon such imports. IEP has not even discussed these risks.

8.2 Energy Plantations

While referring to the need to harness the renewable energy sources, IEP seem to consider only large size grid interactive power plants. In this regard the recommendation has been to establish

energy plantations growing trees suitable for bio-energy. While this recommendation to use the need for compensatory afforestation to be used as opportunity to develop energy plantations may seem to be a green idea, there is a danger of diverting agricultural lands for such plantations unless stringent measures are implemented. If large size bio-mass based power plants are to be established there will be undesirable pressure on fertile agricultural lands to grow non-food crops. Serious implications of diverting agricultural lands to such non-food crops are already being reported from other parts of the world, especially Brazil and USA. Our future energy policy must take such externalities into objective account so as to achieve the welfare of alls sections of the society. In search of energy security the food security should not be compromised.

As discussed earlier, the renewable energy sources are most beneficial when they are harnessed locally instead of large sizes in few locations only. The bio-fuel species such as Pongemia have been growing in our villages for hundreds of years on non-agricultural lands, on the fringes of the farms and agricultural fields, at the fences of the residences etc. Put together at the country level such spaces provide a huge base for growing bio-mass in adequate quantities without endangering food crops. Additionally, the conversion of most of such biomass to energy in distributed fashion at the level of communities through commercially viable models will greatly assist in economic development of the rural communities.

Dedicated estates to grow bio-mass / bio-fuels, as recommended by IEP, must be carefully reviewed to strictly avoid diverting the agricultural lands. With already a huge population base and growing all the time, our country cannot afford to experiment on a critical issue such as food security.

8.3 No mention of peak use of fossil fuels

At the international level there is a preponderance of acceptance of the need to reduce /contain the consumption of fossil fuels in order to check the Global Warming phenomena from running out of control. Many institutions like Inter Governmental Panel and Climate Change (IPCC) have clearly suggested that the consumption of fossil fuel should peak as soon as possible. Some of these credible scientific reports indicate that this should happen during next 10-15 years. Many countries like Norway and New Zealand have already announced their plans to achieve such peaks before 2020.

Steve Mohr of Australia's Newcastle University has modeled the earth's fossil fuel reserves and has come up with a massive study (“PROJECTION OF WORLD FOSSIL FUEL PRODUCTION WITH

SUPPLY AND DEMAND INTERACTIONS"), wherein peak production of fossil fuel is estimated. According to it:

Coal - Year 2019 (212–214 EJ/y).

Oil - Year 2011-12 (179–188 EJ/y).

Natural gas - Year 2019 (143-157 EJ/y).

IEP has not even discussed this issue, let alone suggesting a peak year. Unless we start looking at this issue seriously and urgently India will not only be blamed for it, but will also face the consequences of not being prepared for such an eventuality. For example; if the coal production at global level start decreasing after 2019, and if India continues to build coal power plants even after that period to rely on imported coal to any extent, the coal supply to such power plants may be severely affected in the subsequent years and/or the cost of such supply may become unacceptably high.

There is already tremendous pressure on fast developing countries like China and India to reduce their GHG emissions. In this context it is essential that we work on a plan to reach the peak consumption by a certain time frame at least in case of coal and petroleum products. A tentative target year such as 2020 or 2025 to reach peak consumption of coal may help us to focus our efforts to manage our energy demand/supply situation accordingly. Suitable policies by the state and union governments in this regard will also enable the public and private institutions to channel their resources into developing credible alternatives. Without such a target year we will continue to depend on imports and also run the risk of growing into the largest emitter of GHGs.

A large number of small size diesel/electricity generators, in the power range of 1- 10 kVA are known to be running all over the country to meet the needs of commercial establishments. These are known to be highly inefficient and causing local atmospheric pollution. Such applications of diesel should be heavily discouraged by improving the reliability of grid supplied electricity and by suitably taxing such diesel usage. A considerable portion of these applications are known to cater to lighting needs only, which can be effectively supplied by solar PV panels. A rigid time line to achieve these targets, such as 2015, should be drawn. Adequate and carefully targeted investments in popularizing the renewable energy sources seem to be the most suitable option available to us in this regard.

8.4 Recommendation for creating coastal infrastructure for import and use of coal

While making such a recommendation IEP has failed to consider objectively the socio-environmental impacts of a large number of

coal power plants in the ecologically sensitive coastal regions. Most of the coastal regions of the country are densely populated, and a majority of the people there depends on the natural resources such as ocean, estuaries, wetlands, fishing, coconut and paddy crops etc. Massive burning of coal, which is most likely to occur with the implementation of IEP recommendations, in such sensitive areas will devastate these resources and make the locals destitute in their own lands. Vulnerable sections of these regions such as fishermen, with no other professional skills, will be devastated with polluted oceans which certainly will impact the fish population.

Most of the coastal regions have wetlands, which are ecologically very important. A large number of coal plants proposed/being implemented on the coast of Andhra Pradesh, Tamil Nadu, Orissa and Maharastra will ruin these rich habitats for bio-diversity, and deny the associated benefits to the locals. Availability of fresh water is already a serious problem in these areas, and coal dust can endanger even the existing fresh water resources.

8.5 Deficiency in focusing only on centralized power infrastructure

IEP seem to have focused only centralized electricity infrastructure with large size power plants in few locations and a complex network of transmission, sub-transmission and distribution lines and equipment taking electricity to all corners of the country. IEP has failed to consider the serious problems with such a large network. The low levels of efficiency, huge complexity in its planning and operation, the economics, the bias against rural areas etc. in the centralized electricity infrastructure have been ignored.

If we look at the grid based coal power plants, which are predominant in Indian scenario, the dismal picture becomes evident. Due to technological constraints about 67% of the heat energy available from the coal is lost in a coal power plant; about 25 to 30% of the remaining energy in the form of generated electricity is lost in transmission, sub-transmission and distribution to widely distributed loads. These losses effectively mean that only about 10% of the coal energy may be put to economic/productive uses.

The distributed type of renewable energy sources will fare far better in this regard. Solar photovoltaic panels that are in commercial use now have already achieved solar energy conversion efficiency levels of 13- 15%. If these are used close to the usage points, such as roof top panels, the energy loss in the associated T&D is negligible. The efficiency of solar photovoltaic panels is reported to have reached about 25 to 30% in laboratory

conditions with improved material technology. Wide spread use of distributed renewable energy sources will also reduce the overall T&D losses in the overall system by largely meeting the smaller loads locally.

A new report by Oil Change International, released on the eve of the World Bank's Annual Meetings, dispels the myth that World Bank support for coal and oil projects increases access to energy for the world's poorest. This finding stands in contrast to government, Bank, and industry claims that ongoing taxpayer support for these large coal and oil projects is necessary to alleviate energy poverty. The World Bank has used arguments around increasing energy access – providing energy to the 1.4 billion people who lack access to electricity or the 2.7 billion still using wood or biomass for cooking and heating – to justify the approval of massive new coal-fired power plants like the Eskom plant in South Africa, as well as the continued funding of oil projects. But both Oil Change International's original research and the Bank's own analysis show that none of the Bank's coal or oil lending for the last two years have prioritized increasing energy access.

"World Bank officials justify massively polluting coal and oil projects by saying that they increase energy access for the poor – but that's just not true", said Elizabeth Bast of Oil Change International. "Our analysis and the World Bank's are remarkably similar. Energy from the World Bank's coal and oil plants go to support big industry, not the world's poorest."

Useful References:

"PROJECTION OF WORLD FOSSIL FUEL PRODUCTION WITH SUPPLY AND DEMAND INTERACTIONS"
http://ogma.newcastle.edu.au:8080/vital/access/services/Download/uon:6530/SOURCE4?view=true

"Towards a sustainable power policy in Karnataka": http://mitramaadhyama.co.in/?p=2276

Chapter 9

Holistic view of overall welfare of the society:

through Costs & Benefits Analysis

Key terms: true costs and benefits; overall welfare; direct and indirect costs; objective assessment, economic analysis; CBA, Net Present Value (NPV), pay back period, Internal Rate of Return (IRR)

Chapter summary

In order to ensure a holistic view of overall welfare of the society from power sector perspective, the need to make Costs & Benefits Analysis (CBA) as an essential & objective part of the project approval process cannot be ignored any longer. Such a CBA can assist in capturing all the direct and indirect costs and benefits, so as to enable a wider section of the society to get convinced about the real need for a given power project. An important aspect of such a CBA is that it should involve consideration of as many feasible alternatives as possible in the pursuit of a given objective; and that it should involve transparent public consultations.

9.1 Absence of holistic approach to overall welfare of the society

In recommending huge addition to coal based, dam based and nuclear based power capacity IEP has completely ignored the true costs to, and thereby the overall welfare of the society through the implementation of such additions. Without an objective assessment of all the direct and indirect costs of such conventional power plants to the society, including the inevitable impact on Global Warming, the society cannot determine whether a particular technology or an individual project is more beneficial than true costs to the society.

Without a rigorous economic analysis it is impossible to determine whether a coal based, OR dam based OR nuclear based power plant is most suitable in a given circumstance and in a given geographical location. Hence it is sad that even a high level discussion of various options available and the costs and benefits of these options is not being compiled for projects of such societal importance in the existing approval process. It is even deplorable that IEP as a medium to long term policy document has not even discussed this crucial economic analysis tool, and has lost track of the need for a holistic

approach to the welfare need of our society.

9.2 The need for and the mechanism of Costs & Benefits Analysis

As a developing country with huge poverty levels and aiming towards a welfare society, we need to be absolutely certain that every resource and every rupee spent brings maximum benefits to the whole society; not to just to the project developer. Without a rigorous economic analysis how can we be sure that: a nuclear power park proposed in Konkan coast will not cost many times more than the true ecological value of the environment/economy to be impacted there; OR the UMPP proposed in Krishnapatnam, Andhrapradesh, will bring in much more benefits to the local fishermen and farmers community than the potential threat to their livelihood; OR a cascade of dams on river Subansiri in Arunchala Pradesh will not result in more damages to the local economy than benefits etc.?

Only an objectively conducted Costs & Benefits Analysis (CBA) can provide satisfactory answer to such questions. CBA can be an effective mechanism to determine the least cost option for the society in a given situation. If deployed objectively, CBA can capture all the direct and indirect costs and benefits to the society of a given project. It can also provide a realistic comparison of economic value of costs and benefits of various options. Advanced countries resort to such a rigorous economic analysis to determine the viability of power projects. This route if taken up logically will mandate the project developer to discuss all the credible options to achieve a given objective (let us say meeting the increased demand for electricity for a city); take 3 or 4 of the best options from the group of credible options; subject each of them to CBA; compare them; apply sensitivity analysis to the best two/three options; and then only submit the best option for approval along with the detailed explanation as to why the next best option/options are not considered. Such a rigorous economic analysis through CBA would entail all the direct and indirect costs to the society, include the sustainability option and any intangible costs and benefits.

The sensitivity analysis as an essential part of CBA will help to reduce the uncertainty associated with costs and benefits. In this analysis, the estimated costs can be increased and/or benefits decreased by 5, 10 or 20%, to see how various indicators such as Net Present Value (NPV), pay back period, Internal Rate of Return (IRR) or the ratio of benefits to cost will vary. As a much more vigorous analysis the costs are increased and the benefits are decreased at the same time to determine how credible a given option is. Sensitivity analysis in these options can reduce the uncertainty associated with costs and benefits. An objective comparison of all these options can provide the best option from the society's perspective.

There are concerns that such CBA can be very subjective. But the very process, if made transparent and allowed public scrutiny, will bring out many issues to the fore, which the stake holders can discuss from society's perspective. But in the absence of such a tool as of now, we cannot even discuss the same.

As a densely populated country with limited resources, our society needs all such credible analysis tools to be deployed objectively to choose a technology so as to get maximum benefit for the entire society, instead of blindly following business as usual scenario. It is tragic that IEP has not even referred to the costs and benefits to the society of various technologies it has recommended.

Without the mandate to provide such a rigorous analysis the project developers, including the Public Sector Undertakings, are known to be proposing ill-conceived project proposals. It is a matter of concern that many such ill-conceived project proposals may be getting clearance to implement the project with disastrous consequences to the society. One example each of a hydel/coal/nuclear project can better illustrate the relevance of CBA mechanism in finding the best option amongst various alternatives available in a given situation.

> Karnataka Power Corporation Limited (KPCL) had proposed a 400 MW Gundia hydel project in thick rain forests of Western Ghats, Hassan district. The benefit of this project was mentioned as certain quantity of electrical energy at a low annual load factor of about 35%. But the societal costs involved can be identified as huge. If an objective CBA is applied to this situation, many other credible options can emerge: (1) can we get 400 MW equivalent from replacing all incandescent lamps in the state with CFLs?; (2) can T&D loss reduction in the state from the present level of about 25% to 10% provide more MW of virtual additional capacity?; (3) how much power can be generated by the bio-mass of the identified forest of the project on a sustainable and environmentally friendly manner?; (4) how much savings in energy can be achieved if this project cost of about Rs. 2,400 Crores is deployed in energy efficiency and energy conservation measures within the state? All the associated costs and benefits of so many options can be rigorously analysed.
> Even without a detailed economic analysis it is evident that the alternatives in this case have much better benefits to costs ratio. But in the absence of any legal mandate for such CBA, the project developer has proposed only one option. In such a situation the burden of undertaking such CBA studies is left to the civil society.

A typical case study with high level of costs may exemplify the importance of comparing different options for meeting electricity demand for a coal power projects also is shown (Annexure- 16).

Another illustration of how an objective consideration of direct/indirect costs and benefits to society of different options

available can indicate the futility of pursuing large power plants such as the Jaitapura Nuclear Power project in Mahrastra (Annexure 17). Whereas the proposal by the project proponents envisages building 6*1,650 MWe nuclear reactors at a total estimated capital cost of about Rs. 200,000 Crores (as indicated Dr. A Gopalakrishnan, Former Chair, AERB), there are very many direct and indirect costs to the society, which are not generally included in such projected costs. While the true benefits to the society from this project is estimated to be about 6,300 MW maximum power and about 44,000 MU per year of energy (after taking into account losses in the system), there are many alternative options available to our society to realize these two benefits at much less overall cost. It is a very valid question as to why the government cannot consider such benign options as compared to the costly/risky options.

An oft repeated statement in IEP is that the capital cost of new and renewable energy sources is exorbitant. Without taking all the direct and indirect costs to the society in respective life-cycles of different projects based on conventional technology, comparison of these sources on capital cost basis only with renewable energy sources will never be pragmatic. Whereas the coal, nuclear and dam based hydro power industries have enjoyed patronage in the form of many subsidies, tax holidays and freebies for a number of decades, the new and renewable energy sources had no such comparable patronage in even in the last 15-20 years of their true existence. The externalities of the conventional energy sources, such as social, health and environmental costs which have been conveniently ignored in such comparison, if taken into objective account will clearly tilt the balance in favor of new and renewable energy sources. Additionally, since the fuel costs and O&M costs are negligible in case of new and renewable energy sources, if we compare the life cycle cost of the two technologies there will be no doubt as to which ones are better.

Whereas the capital, fuel and other operational costs of conventional energy sources are increasing every year, the capital costs of renewable energy sources are coming down rapidly because of technological innovations and material development. So much so that many international studies indicate that the cost of the renewable energy sources will be comparable with that of the present grid power costs within few years. Through necessary policy interventions such parity can be hastened. In this context, it becomes pretty clear that if all the direct & indirect costs and benefits are compared objectively, the renewable energy sources

> A UNEP document "Towards a Green Economy – Pathways to Sustainable Development" says: (i) The cost of renewable energy is increasingly competitive with that derived from fossil fuels; and (ii) Renewable energy services would be even more competitive if the negative externalities associated with fossil fuel technologies were taken into account [7.5].

will be much less costly to our society. IEP has failed to do such an objective comparison.

IEP recommendations may indicate that our governments have still not realized the grave energy crisis we are facing today, and the fact that it will worsen in the future in a business as usual scenario. Despite the huge subsidies spent on energy sources such as kerosene and electricity, poor people still have no access to a reliable and safe fuel/energy. It is yet to recognised by the STATE that most of the benefit of "free electricity" in agriculture sector may be going to a small percentage of rich and middle class farmers.

A modest understanding of the crises within the power sector, may lead to the conclusion that an objective application of CBA model to conventional power projects is likely to reveal their unacceptably high costs to the society, and the fact that the benefits from it largely accrue to the project developers.

9.3 The responsibility to undertake Costs & Benefits Analysis

Though the need for CBA mechanism itself may not be questioned by anybody, there are genuine concerns as to how to ensure that the mechanism is not abused or not allowed to be made ineffective as has happened to certain provisions of many Acts of our parliament or as even in the case of some regulatory bodies. There may also be some cases of cynicism expressing doubts that the CBA can become subjective instead of being objective.

One cannot deny the possibility that like all other mechanisms/provisions of law, CBA also can be abused depending on the persons involved. But if this mechanism is objectively thrown open to the public with adequate notice, there are credible chances that one or the other section from the Civil Society will have an opportunity to study the official version of the mechanism, and call for corrections. Relief also is feasible when such an official CBA can be challenged in the court of law. But a salient characteristic of CBA is that it will look at all the credible alternatives. With this provision many sections of the society can comment on it and also participate in the discussion. But as of now there is no mandate for such a CBA, and hence no one owns such a responsibility; certainly not the Ministry or the project developers.

One way of ensuring effective participation by the stake holders is to mandate that the official version of such a CBA be published for a given period (say 2 to 3 months) in the website of the concerned govt. agency as well as that of the project developer. Notification of the same should be given in the media as is required for the public hearing on EIA now. A public hearing for CBA either along with EIA public hearing or a separate one can be considered.

Essentially the onus should be on the project developer to prove to the Civil Society that the considered option/technology is the best option from the society's perspective amongst all the credible alternatives. If not anything else, such a requirement will force the project developer to consider various options, reluctantly though.

Are there constraints for the project developer to undertake objective CBA because his brief is limited? For instance, the UMPP project sites are already identified by Government of India before bidding by developers. So it should be the Government of India/state which is ideally placed to do a CBA before deciding on UMPPs followed by site identification. Now who in the Union government would be interested in a CBA? Probably the Ministry of Power may not be interested though in reality it should be the responsibility of that Ministry. Because, being the implementing Ministry of IE Act 2003, there can be no doubt that various mandates of the Act binds MoP to that important responsibility. Even if the law mandates that a ministry undertakes the CBA, there can be an inherent conflict of interest and the alternatives explored could be a rigged set so as to justify what has already been decided.

So, should the law mandate that whenever a question of public policy is involved in a large project, a detailed CBA should be done for at least 4-5 alternatives? Is there a case for a separate Ministry (directly under the PM just as the DAE is under him) exclusively for this purpose? Or can the role be assigned to the Planning Commission which has been described as an extra constitutional authority over the years, by some people, but could now be given constitutional status and assigned this core responsibility? Central Electricity Authority (CEA), which has been entrusted with Techno-economic concurrence for hydel projects, may also be mandated to undertake the CBA as an alternative.

This book may not be a good place for discussion on such administrative/ legal matters. But it is critical that all the direct and indirect costs to our society of a chosen option/method/technology, and its comparison with other credible options are ensured (as has been exemplified by few cases of CBA in this book). The Civil Society has an important role to make CBA as an effective decision making tool.

Swiss challenge method is adopted by many countries when they have to find a solution to a problem and anybody is free to offer their proposals. This would be the ultimate way but for that our society may not be ready yet. However, involvement of public in CBA has to be seen in the context of what is happening on the regulatory front even after 14 years since regulatory commissions have come to existence in the power sector. There is poor participation from the public; we have very few members who are informed; those who are informed lack the time and energy to

devote to such public hearings. So, whatever is needed to educate the public and ensure in effective participation needs to be undertaken if we hope to have an effective power sector.

9.4 Unscientific pricing and subsidy regime

A major issue with the financial status of the electricity companies in India has been the unscientific pricing of electricity supplied to end consumers. Coupled with poor revenue collection efficiency and inappropriate subsidy regimes such pricing policy has rendered the financial status of the electricity companies unsustainable.

The National Electricity Policy had stated in 2005: "Out of total energy generated, only 55% is billed and only 41% is realised. The gap between average revenue realisation and average cost of supply has been constantly increasing. During the year 2000-2001, the average cost of supply was 304 paise per unit and average revenue per unit was 212 paise per unit." This situation has not changed much even in 2012; it seems to have even deteriorated further. As per the report of the 13th finance commission, which was tabled in the parliament on 25.2.2010, unless the public utilities engaged in transmission and distribution of electricity take urgent measures to improve the efficiency of operations the combined losses at the national level may increase from Rs. 68,643 crores in 2010-11 to Rs. 1,16,089 cores by 2014-15. As per media reports the combined loss to the nation because of the prevailing inefficiency in the power sector is estimated to have already crossed Rs. 125,000 Crores in year 2011-12.

This situation cannot be allowed to continue, and hence urgent corrective measures are needed to determine the true cost of supply to each category of consumers, recover the costs fully through scientific pricing policies, and restructure the subsidy regime to make it really meaningful. Rational pricing policy and the associated regulatory measures are also known to assist in containing the effective demand on the power grid.

Useful References:

"Economics of Hydro Power", Dr. Bharat Jhunjhunwala

"Economics of River Flows", Dr. Bharat Jhunjhunwala

"Power Sector Inefficiency – Economic & Legal Implications": http://mitramaadhyama.co.in/?p=1763

Chapter 10

The Way Forward

- need for a paradigm shift in power sector

Key terms: DSM, efficiency, conservation, cost effectiveness, equity, life line electricity, Energy Service Companies, Polluter Pays, Consumer Pays Principle

Chapter Summary

Only through an integrated energy resource management approach it is feasible to meet the legitimate demand for electricity of all sections of our society on a sustainable basis. Highest possible efficiency, minimum wastages, responsible usage, and wide spread usage of renewable energy sources should be the basis of such an approach, which will not be feasible without involving all the stakeholders in every stage of the decision/policy making processes. For each MW of shortage or additional demand all possible options available (the first and the foremost option being the efficiency improvement) must be considered, and the best option to the society must be implemented. A paradigm shift in power sector is needed. Through this approach there can be minor hardships to some sections of the consumers in the short term, but such hard decisions are inevitable for the overall welfare of the society in the long run.

There can be no doubt that our society needs a paradigm shift in the way we view the issues of power sector if the interests of the vulnerable sections of the society and the environment are to be protected. The need for a complete overhaul of the sector cannot be ignored anymore.

10.1 Recognising the areas of concern in the existing system

A crucial step in any reform process is to objectively recognise the areas of concern in the existing system so that appropriate course corrections can be applied to each of those areas. Our own recent past experiences and many national and international studies/reports have mentioned the following as the major areas of concern in the power sector of the country today.

- Lack of professionalism at all levels including the organizational/sectoral level management;

- Undue political interference in the day to day affairs of electricity companies;
- Gross inefficiency at all levels of operation: generation, transmission, distribution, service delivery, planning, project implementation, demand projection, energy utilization, information management etc.;
- Non-remunerative pricing structure for the electricity produced and sold;
- Lack of holistic approach to the true welfare of the society;
- Unscientific and untargeted subsidy regime leading to financial instability of the sector;
- Absence of compulsory & accurate metering and cost of supply calculations;
- Largely ineffective regulatory mechanism; lack of public participation;
- Poor revenue collection efficiency and financial management;
- Lack of understanding of the social and environmental obligations;
- Poor implementation of the relevant Acts of the parliament.

10. 2 Good recommendations in IEP

IEP has made many good recommendations. Such recommendations combined with a holistic approach on all issues relevant to power sector shall be able to provide us with a credible framework for a people centric, environmentally friendly and sustainable set of policies.

- IEP has clearly recognized the need for, and huge potential savings in effective demand side management (DSM), and has strongly advocated some measures in that direction.
- Time of day metering; day light savings; energy audit for loads in excess of 1,000 kVA; energy efficiency standards and measures; improving PLF of thermal power plants; mandating only efficient steam boilers for coal power plants are all good recommendations.
- It has advocated for least cost planning and multiple resources to meet the energy demand; but it has not extended the logic to all segments of energy supply.
- There is a strong recommendation on providing some equity in energy availability to the poor by providing a minimum life line electricity of 30 Units per month per family free of cost.
- Clear recommendation to accurately measure electricity supplied to each consumer.
- Has mooted the novel concept of Energy Service Companies (ESCO) for harnessing the huge potential in energy efficiency and DSM.

- Emphasis on R&D for developing new generation technologies; A National Energy Fund (NEF) has been recommended to finance energy R&D. New generation technologies discussed include coal technologies for efficiency improvement; in-situ gasification; Integrated Gasification Combined Cycle (IGCC) and carbon sequestration; solar technologies covering solar thermal and photovoltaics; bio-fuels such as bio-diesel and ethanol; bio-mass plantation and wood gasification, and community based bio-gas plants.
- Recommended new coal power plants with high efficient boilers only;
- Recommendation for charging true cost of supply of energy;
- Recommends a consistent application of “Polluter Pays” and “Consumer Pays” Principle; a person or a company which is the cause for pollution should pay appropriately to the society as a fine OR to set right that pollution; also the individual/company who consumes energy or consumes a natural resource should pay appropriately to the society for that usage.
- Public sector autonomy to energy companies to ensure a commercial culture;
- Promotion of solar hot water systems and efficient lighting initiatives,
- Suitable compensation to the resource rich states for sharing their resources with other states.

10.3 Need for Integrated Resource Management

In view of the huge deleterious impacts of large conventional power plants on social, economic and environmental aspects of our society, sustainable alternative to meet the legitimate demand for electricity can be feasible only through an integrated energy resource management approach. Such an approach consists of deploying that combination amongst the available options which not only meets the electricity requirements satisfactorily, but at least overall societal cost. It should basically include effective demand side management (DSM), most efficient use of energy sources/services, optimum level of energy conservation, and widespread use of new & renewable energy sources. The dependence on conventional energy sources should be gradually reduced until the new & renewable energy sources can effectively replace them, and should be targeted to be completely eliminated in the medium term. In this context few statements associated with official agencies of the govt. would provide proper perspective.

In 2009 the govt. has made a voluntary commitment to international community at Copenhagen to reduce its energy

intensity between 20-25 % by year 2020. This recognizes the potential in reducing the electricity demand. But it represents only a part of the huge potential for virtual capacity addition existing in the prevailing infrastructure in power sector.

> The National Electricity Policy states: "It would have to be clearly recognized that Power Sector will remain unviable until T&D losses are brought down significantly and rapidly. A large number of States have been reporting losses of over 40% in the recent years. By any standards, these are unsustainable and imply a steady decline of power sector operations. Continuation of the present level of losses would not only pose a threat to the power sector operations but also jeopardize the growth prospects of the economy as a whole. No reforms can succeed in the midst of such large pilferages on a continuing basis."

IEP itself says: "India's conventional energy reserves are limited and we must develop all available and economic alternatives. … Clearly over the next 25 years energy efficiency and conservation are the most important virtual energy supply sources that India possesses."

> "India's power sector is a leaking bucket; the holes deliberately crafted and the leaks carefully collected as economic rents by various stake holders that control the system. The logical thing to do would be to fix the bucket rather than to persistently emphasise shortages of power and forever make exaggerated estimates of future demand for power. Most initiatives in the power sector (IPPs and mega power projects) are nothing but ways of pouring more water into the bucket so that consistency and quantity of leaks are assured …."
>
> *Deepak S Parekh, Chairman, Infrastructure Development Finance Corporation, September 2004.*

IEP also estimates that CO_2 generated from the energy sector use can be reduced by 35% through effective deployment of efficiency, DSM measures and renewables. IEP's main action recommendation for energy security is: "… relentlessly pursue energy efficiency and energy conservation as the most important virtual source of domestic energy".

> As the Bureau of Energy Efficiency (MoP, Govt. of India) has estimated, at the prevailing cost of additional energy generation, it costs a unit of energy about one fourth the cost to save than to produce it with new capacity.

As per IREDA, under the Ministry of Non-Conventional Energy (NCE) Sources: "Promotion of energy conservation and increased use of renewable energy sources should be the twin planks of sustainable energy policy."

IEP itself has projected a total installed capacity based on renewable

energy sources of 90,000 MW by 2031-32 consisting of 30,000 MW of wind power, 10, 000 MW of solar power, and 50,000 MW of bio-mass power. But the National Solar Mission under NAPCCC, itself is aiming at adding 20,000 MW of solar power by 2020.

> The National Electricity Policy also states:
> "Out of total energy generated, only 55% is billed and only 41% is realised. The gap between average revenue realisation and average cost of supply has been constantly increasing. During the year 2000-2001, the average cost of supply was 304 paise per unit and average revenue per unit was 212 paise per unit."

Many international agencies have come up with studies indicating techno-economically viable mixture of measures to meet global electricity needs during next 3-5 decades without having to add many conventional power plants. An important aspect in this regard is the vast scope existing in improving the overall efficiency in the usage of the existing power infrastructure to the international best practice levels, which alone can reduce the power demand on the integrated grid in India by as much as 40%, as per author's own estimation. Measures in this regard can be seen as low hanging fruits with low costs and very small gestation periods as compared to the green projects based on conventional power generation technology.

In the context of these issues it becomes obvious that efficiency improvement alone in each segment of power sector has the huge scope for eliminating the crippling power cuts for next few years. Along with it DSM and energy conservation together can drastically reduce the need for additional power generating capacity for the next few years. Maximum focus should be provided for these measures. Any amount of financial and political investment in this aspect is worth the difficulties involved. These measures provide perpetual benefits at approximately 25% of the cost of new generation capacity, and at least overall cost to the society. Without undertaking these measures it would be futile to increase the generating capacity alone.

Many countries have not permitted coal power plant in recent years, and instead focused on solar and wind power. Spain and Germany are leading in harnessing solar and wind power. Being a tropical country India is endowed with huge potential in this sector, and has no reason not to focus heavily on renewables. Also, being an agrarian country the bio-mass available for

harnessing energy in India is huge, widely distributed and highly suitable for accelerated rural electrification.

Renewable energy, combined with efficiencies from the 'smart use' of energy, can deliver half of India's primary energy needs by 2050, according to the Greenpeace report: 'Energy [R]evolution: A sustainable Energy Outlook for India' (Annexure 18).

A study by Earth Policy Institute, Washington had looked at ways and means of reducing the CO_2 emissions to contain Global Warming. This report says that the energy resources and the existing technologies available throughout the world can reduce the reliance on fossil fuel drastically ("Time for Plan B: Cutting Carbon Emissions 80% by 2020" : Annexure 19).

What all these statements indicate is that there are credible ways of meeting the legitimate electricity demand of our country by environmentally and people friendly methods than through additional conventional energy sources such as fossil fuels or dam based hydro or nuclear power. India could be a leader in harnessing the same since our life style is congenial for low per capita energy consumption. Many countries around the world are resolutely moving towards such sustainable options, whereas our country has not done enough even in optimally utilizing the existing energy infrastructure. What is inevitable in this regard is the urgent and concerted action plans at all levels by various organs of the STATE. Unfortunately IEP seem to have ignored the urgency to move towards this scenario.

T&D losses in the country is about 25%, which if brought down to the international best practices level of about 5%, can provide 20% of peak demand met as virtual additional power capacity. Alternatively, it can be seen as having potential to reduce the effective demand on the grid by about 20%. Within the country there are few pockets of much lower AT& C losses such as Bangalore city (less than 10%), Mangalore Electricity Supply Company, Karnataka (less than 14%) etc. It is known to be techno-economically viable to reduce these losses below 10% easily, as demonstrated by the MoP's target of reducing it below 15% in 11th plan period.

> What our society is doing at present is to supply inefficiently derived electrical energy from limited conventional sources at subsidized rates for highly inefficient and /wasteful end uses, for which the real subsidy cost will be debited to the account of future generations.

Table 16: T&D losses (2009 – 10)

Region	Losses (%)
Northern Region	27 (Range from 20 to 64)
Western Region	26 (Range from 13 to 35)
Southern Region	19 (Range from 14 to 20)
Eastern Region	27 (Range from 21 to 42)
N E Region	34 (Range from 29 to 64)
All India	25

(CEA, Agenda for 18th EPS Report)

Table 17: Typical T&D losses across Globe

Country	T&D Losses (%)
India	25
Russia	12
UK	8
China	7
USA	6
Japan	4
Germany	4

(Source: CEA/power Ministry)

In this context a high level analysis of the power scenario in the country throws up an interesting picture, and may point towards a viable solution to the power sector woes.

- Installed Generation Capacity (As on 31-3-2012) was 199,877 MW with 175,377 MW of conventional power and 24,500 MW of renewable power (as per CEA website)..
- The peak power and annual energy demand for year 2011-12 was 130,250 MW and 936,568 GWH (as per CEA website). When this peak power demand is compared to the capacity available in the system, it allows a spare capacity of about 45,000 MW of conventional power capacity alone. Allowing for 10% outages and 10% reserve (a total of about 26,000 MW) the system seem to have surplus of about 19,000 MW installed generating capacity without taking into account the renewable power capacity.
- The deemed peak demand on the grid of 130,250 MW during 2011-12, when viewed from the perspective of gross inefficiency prevailing in the sector means that in real term it is much less. CEA itself admits that there is a saving potential of 15% in the end use (as per Table 12.1 of its draft generation plan for 12th and 13th Five Year plans). The T&D loss reduction of 10% is techno-

economically feasible during the 12th and 13th plan periods if adequate emphasis is provided. Through DSM the actual peak demand on the grid can be brought down further.

- Even assuming the demand reduction potential of only 25% (15% from end uses PLUS 10% from T&D losses), the true demand on the grid as on 31.3.2012 could have been only about 98,000 MW of peak power, and 702,426 GWH of annual energy during 2011-12.
- On the basis of these figures for the peak power and annual energy demand as on 31.3.2012, and at an assumed CAGR of 4% demand growth, the power demand in the country can be projected as 139,485 MW of peak hour demand and 999,771 GWH of annual energy by 2021.
- What this basically means is that the power sector may not need a lot of additional capacity, if the existing infrastructure is put to use optimally.
- But it requires concerted efforts not to allow the true demand on the grid to escalate without checks, and to increase efficiency at all levels/segments of the power sector. Anyway, this approach has also been advocated in the CEA plan. There can be no doubt that our dense & hugely populated society cannot afford to permit unchecked demand growth. Fortunately, there are many credible methods of reducing the demand to manageable levels without having to compromise on community welfare activities.
- It appears credible that by increasing the operational efficiency of the existing power plants alone the projected demand on the grid by 2021 (end of 13th plan period) can be comfortably met. This requires taking the average PLF of coal power plants to about 85%.
- This should be done by replacing all the old and inefficient coal power plants (those generating plants of capacity less than 250 MW and PLFs less than 70%) by supercritical coal power plants at the existing sites to reduce the need for additional land, water and other infrastructural facilities. This process should be planned to be continued in 14th and 15th plans also until the efficiency of every coal power unit in the country is of acceptable standards.
- As compared to the huge logistical and societal problems associated with the planned capacity addition of about 79,000 MW in each of the 12th and 13th plan periods, this approach brings huge benefits to the society while avoiding humongous societal costs.
- In view of the huge potential existing in the distributed type renewable energy sources such as roof top SPVs, CSPs, community based bio-energy plants, wind turbines etc. the additional annual energy requirements in future should be met by them as far as possible, by shifting smaller loads from the grid to

these distributed power sources.

- The huge solar power potential should be made use of to meet the additional peak demand also in future by installing CSPs of 10 to 15 MW capacity at suitable locations (such as each taluka places) to feed to the grid.

CEA /Ministry of Power plans should consider this approach seriously starting from 12th plan period itself.

10.4 Focus areas and specific action plans

As espoused in 'National Mission for Enhanced Energy Efficiency' under NAPCC, the importance of energy efficiency need no special emphasis. Efficiency in all aspects of energy usage and particularly in power sector will be critical for a sustainable future. This Mission is basically targeted at industry, which, according to the NAPCC, accounts for 42% of the country's total commercial energy use (2004-2005) and 31 % of total CO_2 emissions (1994). In view of the power sector's contribution to Global Warming mentioned earlier (in section 6.2) efficiency will be a major factor in the future.

As the clear acknowledgement of maximum possible efficiency in our society, the Government of India had a number of initiatives to promote energy efficiency in place before the NAPCC such as the star labeling system and energy conservation building code. It had also passed the Energy Conservation Act of 2001. In addition to these, the NAPCC calls for:

- Mandating specific energy consumption decreases in large energy consuming industries and creating a framework to certify excess energy savings along with market based mechanisms to trade these savings. This is aimed at enhancing cost effectiveness of improvements in energy efficiency in energy-intensive sectors.
- Innovative measures to make energy efficient appliances/products in certain sectors more affordable.
- Creation of mechanisms to help finance demand side management programmes by capturing future energy savings and enabling public-private-partnerships for this.
- Developing fiscal measures to promote energy efficiency such as tax incentives for including differential taxation on energy efficient certified appliances.

Keeping these initiatives in correct perspective the main focus areas for concerted action plans within the power sector between now and 2032 should be:

- take all credible measures to contain the effective demand for the integrated grid electricity to legitimate uses only which leads to largely economic and welfare activities only; non-

essential/luxurious applications should be mandated to generate own electricity through renewable sources at their premises;

- move resolutely towards ensuring efficiency to international best practice levels in all aspects of demand/supply and usage of electricity; every unit of electricity consumed should be fully accounted and paid for;
- focus on minimizing the wastage of electricity, and avoiding luxurious/avoidable applications such as night time sports, unscientific street illumination, decorative lighting etc.;
- appreciate the urgency to start moving away from the fossil fuels, which are fast running out and causing life threatening Global Warming phenomenon;
- drastically reduce the dependence on dam based hydro power;
- make all possible efforts to shift lighter loads and non-essential loads to distributed type of renewable energy sources;
- move towards a target date of replacing all conventional energy sources by renewable energy sources in the foreseeable future. In this regard the potential of renewable energy sources is proposed to be optimally harnessed by consistent and persuasive policy interventions. Concerted efforts on a war footing are essential to move away from our overdependence on fossil fuels and inefficient methods.

The focus on the following action plans are considered essential in this regard.

I). A considerable portion of the increase in electricity demand between now and year 2032 should be met by the measures such as efficiency improvement, energy conservation and demand side management. There are many credible estimates which strongly suggest that about 30 - 40% of the present demand can be met by these measures, which would have made the existing scenario to be surplus by a considerable margin (table 18).

Electricity demand should largely be restricted for legitimate economic and welfare usage with minimum wastages in applications such as night time sports, decorative lighting, AC shopping malls, advertisement hoardings etc. Peak hour demand should to be managed within 85-90% of the total generating capacity.

There should be huge emphasis to take the overall efficiency levels in generation, T&D, and utilisation towards the international best practices. The performance target should be that by 2032 the T&D losses will not be above 5% in any part of the country, and that the PLF of no thermal power plants and nuclear power plants will be below 90%. Only energy efficient electrical appliances such as lighting systems, TVs, radios, fans, pumps, motors, refrigerators, washing machines, welding machines etc. shall be available in the market by 2020.

Table 18: Power Sector Efficiency in India

Power Sector Area	Prevailing level of efficiency / loss in India	Potential for improvement/savings (percentage of total annual energy)
Generating capacity utilisation	50 - 60%	5-10 %
Aggregate Technical & Commercial losses (AT&C)	35 – 40 %	15 -20%
End use efficiency in agriculture	45 – 50 %	15-20%
End use efficiency in industries and commerce	50 – 60 %	5 -10 %
End use efficiency in other areas (domestic, street lights and others)	40 – 50 %	5 -10 %
Demand Side Management	Potential to reduce the effective demand by more than 20%	

(Source: Author's estimation based on IEP, National Electricity Policy, Annual reports of CEA, and many other reports/article on Indian Power Sector)

Rainwater harvesting and ground water recharging initiatives on a massive scale will help in reducing the electricity demand by considerable margin, and hence should be given a top priority.

II). When the direct and indirect costs due to externalities (such as social, health and environmental costs) are built into the realistic cost of conventional sources, and when various subsidies are removed, the overall cost on life cycle basis of the conventional sources will be more than that of renewable energy sources even

> As per the Secretary, Power, MoP (few years ago), the national overall energy usage efficiency was only be about 10 to 15%; average of PLF was about 65%; if this is to be increased to 80% the peak hour deficit will disappear, and the energy shortage will also go. He has also called for reduction in inefficient consumption, which is about 20 per cent of total power consumed in the country. According to him if 10 per cent savings were made, then the energy shortage also would be wiped out.

today. Greenpeace's 'Energy [R]evolution: A sustainable Energy Outlook for India' (Annexure 18) has projected that with appropriate policy interventions the tariff for electricity produced by conventional power plants and by the new & renewables sources could be almost same within a decade. Latest trends indicate that this can happen as early 2017 in the case of solar power. Hence adequate investments in deploying new &

renewables sources should be undertaken between now and 2032 along with a long term perspective. Most of the lighting loads, and most of the lighter loads of appliances (in residences, agriculture, industries, business, shops, and schools etc.) can be met by distributed type of renewable energy sources such as solar PV panels and solar water pumps.

III). All the necessary measures should be taken to ensure that fossil fuel power plants, including coal power plants, reach peak capacity by 2020/2025. Most of the existing thermal power plants and nuclear power plants should be targeted to be decommissioned OR close to be decommissioned due to aging by 2032. Except for the already approved ones, most of the new coal power plants shall be basically to replace the old and inefficient plants, and shall be of highest possible overall efficiencies, which means that they shall be of super critical boiler parameters only. Most of such power plants shall come on the existing site of the old and inefficient power plants to make use of the prevailing infrastructure and to reduce the acquisition of additional lands. In view of the heavy import component of petroleum products diesel power plants should be completely phased out by much before 2032.

IV). In view of new gas findings in K-G basin and elsewhere, natural gas should be used optimally to reduce the reliance on coal power as a link energy resource until renewable energy sources are able to fully replace the fossil fuels. Gas power plants have much less GHG foot prints than coal power plants, and are also useful as peaking stations.

V). Hydel power plants of size more than 25 MW (25 MW of total plant size to minimize the reservoir capacity) shall not be considered to be built. Only smaller size plants shall be considered strictly on run-of-river basis with a pond size catering to not more than 2 hours of water demand of the plant, and should be approved only for locations where the impact on the environment is considered minimum, such as non-forested areas.

VI). No new nuclear power plant shall be built. Existing units should not be allowed permission to operate after the 25 years of age OR beyond design life, whichever is earlier.

VII).Huge emphasis should be given to develop and harness renewable energy sources as the first option of electricity source for each MW of perceived additional demand. A substantial percentage of the renewable energy sources are expected to be

distributed type such as roof top solar or community based bio-mass plants or wind turbines, either individually or in combination of two or more sources, in order to minimise the additional land requirements and to reduce the T&D losses. Such distributed type energy sources will assist in accelerated rural electrification and reduce overall investment in power transmission and distribution network. Assuming about 30 Crore house holds in the country by 2031-32 (@ 4 persons per house), and assuming that about 10 Crore houses in the country will be suitable and economically able to install roof-top solar photo voltaic systems of 3 kW each, about 270,000 MW installed capacity of solar power in distributed mode is feasible. This capacity may be adequate and suitable to meet most the non-industrial loads in the country.

VIII). The National Solar Mission has a target of adding 20,000 MW by 2020, most of which is assumed to be Concentrated Solar Power and grid interactive solar PV panels. Latest trends of interest to participate in the bidding process of this mission, indicates that with necessary policy initiatives this target can be ramped up to about 60,000 to 80,000 MW by 2032.

IX). The capacity of wind and bio-mass energy sources can be projected keeping in view the potential as projected by IEP in its model, and on the basis that such a potential is for large size grid - interactive plants. Such capacity is expected to increase rapidly beyond 2032 through harnessing the off-shore wind mills and increase in energy plantations.

Many bio-energy plants as part of micro-grids, based on rice husk are known to be functioning satisfactorily in parts of Bihar. Such a novel technology/model should be objectively considered for other villages where the availability of rice husk or other suitable bio-mass can be assured. Mini/micro hydro power plants (of capacity 10 to 25 kW) catering to few house or even for 2 or 3 villages are also reported to be operating satisfactorily in parts of Western Ghats, Eastern Ghats and Himalayas. Full potential of such mini/micro hydro power plants should be harnessed taking care to minimize the environmental impacts.

X). The energy consumption should be measured accurately at various voltage levels and at each consumer premises; effective tariff policy intervention should reduce the energy wastages and minimise the misuse of subsidies. The actual cost of delivered energy should be fully recovered in each category of consumers.

XI). As discussed earlier (in section 7.5) DC home lighting systems

with different capacities (with 20 - 40 Watt SPV, 5-10 A Charge controller, 25 - 60 AH battery, 3 - 5 lights along with wiring) is available in the market for about Rs. 10,000. This option should be seriously considered to electrify all remote villages, and those installations which have unsatisfactory power supply from the grid or those incurring high distribution losses. With a small increase in price such systems suitable for TVs, computers and cell phone chargers can be made available. A substantial number of houses in the country can meet their legitimate electricity requirements through such distributed SPV system, and reduce the existing electricity demand on the power network by about 15-20 %.

The techno-economically viable avenues to get the desired level of energy security are plenty. All it requires is a determined political will and implementation on a war footing.

10.5 Brief discussions on meeting future demand of different sectors of our economy

As has been discussed in the earlier sections our society cannot afford to ignore the reality that the consumption of energy/electricity and natural resources should be minimized for the overall welfare of the humanity on a sustainable basis. If we keep this fundamental requirement in focus, the ways and means of managing our economy on a sustainable basis can become crystal clear. Instead of expecting the regulatory agencies to enforce restrictions on electricity usage it is vastly beneficial to exercise adequate caution at the levels of individual /community /organization / sector. Each sector of our economy has an important role to play in this regard.

Agriculture/farming which is reported to consume about 35% of the total electricity in the country has a critical role not only because of its essential character to food security, but also because of the huge scope for energy/electricity consumption reduction. No section of the farming community is happy with the quality/quantity of electricity it is getting from the grid as of now, even though much of it is not being paid for. Since almost all of the farming activities are best conducted during the day time, solar power is best suited to this sector. Majority of farming communities in India (except those in Himalayas and Sub-Himalayas) get more than 300 days of sunshine each year. Solar power water pumping systems can meet the entire water requirement either on its own or in conjunction with wind mills/turbines or bio-energy systems or both. Electricity for water pumping requirement is maximum during summer or non-rainy days, and hence solar power water pumping systems is most suitable for this purpose. In this context the cost of installing such systems, though may appear high for individual farmers, should be seen as negligible for the state/nation as compared to the total

costs to the nation of not doing so as discussed in the earlier chapters. Such Solar powered systems can be dedicated to water pumping alone or can be a system for both for pumping and the use of other appliances of the farmer such as domestic usage. Community based renewable energy systems are other suitable options depending on the local conditions.

Reduction in grid demand by about 35% through this option can transform our power sector. All possible measures in this regard (even including 50% or 75% subsidy, if required) should be undertaken on a war footing. The necessary investment to the society in this option, however big it may appear in financial terms, is essential from the overall welfare perspective. Such an option through one or more of RE Sources will be of huge benefit to the farming community in terms of reliable access to water, while the State will get perpetual benefits in the form of avoided subsidy year after year; the power network will see highly reduced demand, low T&D losses, better voltage profile, and lower infrastructure and human resources costs; environment will benefit by highly reduced need for conventional power plants, and better control on water usage.

Industries, which are reported to be consuming 20-25% of the total electricity, have huge scope for efficiency improvement, which is not only needed for the society but for the individual industry, because many industries (cement, aluminium, iron & steel etc) have a large energy cost component in their product pricing structure. Indian cement industry is reported to be at the top as far as its specific electricity consumption is concerned. But there is a huge scope for improvement across the industrial sector. The roof top surface available in manufacturing facilities/ warehouses/ offices etc. for installing SPV systems is huge, and such SPV systems can cater to a substantial part of lighting, computing and other lighter load requirements. Industries requiring hot water, such as dairy or hotel industry, can get most of it through solar hot water systems. Sugar industries, which may already have power production facility through the sugar can waste, can also make use of solar PV systems/ solar water heating systems. Through one time investment monthly electricity bills can be considerably reduced and any excess electricity can be sold to the local electricity company.

Commercial sector lighting alone accounts to about 10 to 15% of total electricity at the national level, most of which can be catered to by one or more of solar /wind power systems. Roof top SPV system has huge potential to meet lighting and computer loads throughout, and cooling systems during day time. Commercial complexes can consider having their own jointly owned RE systems close to their premises.

Domestic sector, which consumes about 20-25% of national level electrical energy, is the most suited sector to harness renewable energy sources. Since its applications are generally of smaller capacity and durations, SPVs with back –up battery systems can cater to most of their needs throughout the year. Author's own residence is an example, wherein a considerable amount of electricity needs are met by his roof top SPV system throughout the year, which can/must be replicated throughout the country. These SPVs generate electricity even during cloudy and rainy days, though to a smaller extent. Community level RE systems also have an important role, which can give control of power supply to the locals. As discussed in section 7.5, DC/AC home lighting systems through SPV panels on roof tops can revolutionise the domestic power supply scenario in rural India with careful planning and necessary policy interventions.

Common services such as streetlights and public places such parks, bus/railway stations, offices, educational institutions, recreation centres etc. can meet most of their lighting needs through SPV systems. Municipality water pumping systems, Lift irrigation schemes, sewage treatment plants etc. also can make use of SPVs with careful planning and designs.

CDM benefits which can be obtained by generating electricity through RE Sources should be an attractive option for a community, group of houses, cluster of commercial/industrial establishments, office block etc. Such an option will reduce the effective capital cost of RE Sources.

The state and union governments have a major role in kick starting this option by utilizing the opportunity in the roof top surface for installing SPVs in the offices/ buildings/ residential complexes etc. Education departments in each state can be a pioneer in this regard by seeking to install roof top SPV systems in all educational institutions, which at the state levels may mean millions of electrical energy units eligible for CDM benefits. Similarly, Railways can generate considerable percentage of electricity they consume through SPV systems on train compartments, and railway stations. Public Private Partner ship can be a very good business model to make use of this option.

10.6 Role of responsible water management in containing the electricity demand

As indicated by the huge electricity consumption in agricultural pump sets, the inextricable link between water management and demand for electricity from the grid gets highlighted. If we also take into account the electricity consumed in domestic water pumps, pumping water from reservoirs to urban and rural areas, lift irrigation schemes, water pumping needs for commercial

establishments such as hotels, resorts, theme parks, swimming pools, gardens/parks, industrial usage etc. it will not be an exaggeration to assume that electricity usage in water related applications my be in excess of 60%. In this context the urgent need for responsible management of water is not only important from the power sector's perspective, but also in making this scarce but essential resource accessible to all.

Massive campaign on rainwater harvesting and ground water recharging; appropriate fee structure for water usage in agriculture, urban areas, industries, commercial establishments, and all other non-essential usages so as to bring down wastages and luxurious usage to the minimum will reduce the electricity demand for water related applications, and will also make water conservation an objective for all categories of consumers.

Deploying RE sources to water pumping applications is eminently feasible and highly essential so that the effective demand on the grid can be drastically reduced.

10.7 Critical role of individuals and communities

When we look at the power sector management scenario from a global perspective, the role of individuals become critical. Whether it is in residence, industry, agriculture, business or services the decision by each individual has a critical role in the overall management of the power sector. The individual has to decide how much energy/electricity, and what technology to deploy in all the applications. If he/she keeps a proper perspective of the overall impact on the power sector (and hence on the larger society and the globe) of what his/her decision/action does, the problems gets minimized. If each of us makes conscious efforts to minimise our individual energy foot print directly/indirectly the global impact can be immensely positive.

We cannot afford to leave all the decision to few individuals in the state/central government, but should make all possible efforts to influence such decisions positively. There are various forums such as ERCs, and other regulatory bodies which conduct public hearings on related issues, in which public can/should participate. Many NGOs conduct seminars and workshops on related topics for information dissemination. Civil Society forum at taluka/district levels can be formed where all the relevant issues such as power sector issues can be discussed so that the views of the people reach the state/union government. Without effectively participating in decision making processes, wherever possible, our society cannot achieve the ultimate goal of overall welfare. A common factor which can be noticed in all the developed societies is the effective role of public in decision making processes.

The communities and/or the society as a whole should decide what sort of development is needed for them, which in turn may determine the electricity needs. The Civil Society should engage in public debate as to how many industries / factories /processing plants /enterprises are necessary for a given state / region / district. How many car making units / iron & steel mills / iron mines / plastic industries / chemical units etc. and where and why are all issues to be decided from the society's overall welfare perspective. They should have a say in determining what sort of employment opportunities are suitable for their community/region.

As discussed in section 2.4 the development objective of the country with a high GDP growth rate target, year after year, will mean the manufacture of products and provision of services at an unprecedented pace leading to very high energy demand. It also leads to: setting up of large number of additional factories/manufacturing facilities; consumption of large quantities of raw materials; unsustainably increasing demand for natural resources such as water, minerals, timber etc.; acute pressure on the govt. to divert agricultural/forest lands for other purposes; clamor for more of airports, air lines, hotels, shopping malls, private vehicles, express highways etc. Vast increase in each of these activities, while increasing the total GHG emissions, will also reduce the ability of natural carbon sinks such as forests to absorb GHG emissions. These consequences will also result in depriving the weaker sections of the society even the basic access to natural resources, while driving the fragile environment to a point of no return.

The question we, as an integral part of the Civil Society, need to debate on is whether such a developmental pathway will lead to true welfare of our society. Effective public participation is crucial in adopting a people friendly, environmentally friendly and sustainable pathway for the society. Shall we not consider seeking overall welfare through less energy intensive growth through services sector (IT, BT, education hospitality etc.); agro based enterprises (agriculture, horticulture, floriculture, bee keeping, dairying. fishing, animal husbandry etc.); cottage industries; forestry etc.?

All these years the Civil Society had negligible say in such decisions. The future requires active public participation in all affairs of the STATE. The very objective of this book is to provide the public with necessary information base on the power sector.

While the STATE has the critical role in driving the power sector polices/reforms, there are many initiatives which can be

undertaken by individuals and the sections of Civil Society (including the industries, commerce, residential societies and other institutions) to address the crises being faced by the Power Sector. Some such initiatives are:

- Electricity usage efficiency improvement measures to minimise the electricity consumption in all spheres of our life; personal level commitment becomes very critical in this regard;
- aim to restrict per capita electricity usage for domestic purposes at about 350 kWH per year; author's own experience (discussed in section 2.6) can be a good indicator of such a feasibility; an honest effort to reduce consumption at every application and a conservative use of roof top solar water heater and SPVs for illumination, TV and computer etc. can reduce the demand on grid power;
- widespread usage of energy efficient appliances;
- undertake energy auditing in industries to conserve energy;
- meet as much energy/electricity demand as possible through RE sources at community levels; encourage the local authorities (such as village councils, town/city councils, educational institutions etc.) to use RE sources;
- take into account the minimum life cycle costs while purchasing of electrical equipment like motors, transformers, capacitors, lighting fixtures, refrigerators, fans, TVs, washing machines etc;
- maximize the benefits from time-of-day (TOD) tariffs; reduce electricity usage between dusk and dawn; consider late night time water heating, night time use of large ovens etc. when the demand on the grid in minimum;
- co-operative society concept to meet the electricity needs of a group of houses, shops and industries, as in an Industrial Estate, through local production through renewable energy sources;
- in the medium term consider setting up a Solar CSP generator to cater to a group of industries to eliminate the uncertainties associated with grid supply;
- opt for decentralized electricity supply system by a combination of solar, wind and bio mass for individual small scale industries OR cluster of industries OR communities; consider the use of CDM benefits to reduce the overall capital cost of such initiatives;
- lobbying for policy changes for adequate investment to reduce T&D losses, efficiency improvement, demand side management, suitable subsidy on REs, rationalization of tariff for agricultural sector, energy conservation in homes, offices, schools, street lights, decorative purposes, etc.
- industries can explore Carbon Trading by adopting innovative electricity saving measures;

- educational campaign on the need for high efficiency and energy conservation;
- understand the rationale behind major policy decisions by holding seminars/discussions at the level of local community /taluk/ district/state;
- encourage public debate on all major energy related issues;
- massive campaign for rain water harvesting and ground water recharging in every community;
- massive tree planting efforts at all possible locations will reduce the atmospheric temperature; assist in ground water recharging and hence in reducing the electricity demand on the grid;
- lobbying for suitable legislation on effective public consultation on all major policy issues and on the need for objective Costs & Benefits Analysis as a decision making tool.

Section 10.8: Climate Change Risk Adaptation in Power Sector

A major consideration in planning for the power infrastructure for the future shall be of the impacts associated with Global Warming. A 2012 report by Asian Development Bank (ADB) "Climate Risk and Adaptation in the Electric Power Sector" has focused on the possible impacts on different aspects of power sector due to Climate Change expected during next few decades. (http://www.adb.org/publications/climate-risk-and-adaptation-electric-power-sector).

It has listed a number of potential causes for concern. Some of them are:

- "By 2030, fossil fuels (coal, gas, and oil) are expected to continue to generate more than 70% of electricity in the DMCs (developing member countries). The power sector alone will continue to contribute approximately half of the region's total CO2 emissions by 2030, with a corresponding contribution to the increase in atmospheric concentration of greenhouse gases."
- "Climate change is expected to affect the entire electric power sector: fuel mining and production, fuel transportation to power plants, electricity generation, transmission through high voltage grids, and low voltage distribution to consumers. Patterns of energy load growth and end-use demand by consumers will also be altered by climate change. "

The report says: "Given the rapidly increasing growth in energy

use in the region and the large investments required in coming decades, attention must be given to ensuring a full accounting—and management—of risks to these investments related to climate change."

The report has attempted to analyse various factors which may impact the power sector, and highlighted the exposure and vulnerability of the power sector in Asia to climate change. It has also suggested adaptation options available to each source of energy generation as well as for the distribution and end use of electrical energy. A quick look at the report indicates the high probability of one or more factors affecting India's power network, demanding much closer attention than that has been conceived so far.

Indicative impacts of climate change on electricity generation, transmission and end use w.r.t various forms of electricity sources such as coal, gas, hydro, nuclear, and renewables indicates that the renewable electricity sources will face much less risks due to climate change as compared to conventional power sources. Amongst the renewable sources solar photo voltaic panels may face minimum number of risks. As compared to MW size SPV panel sites such as solar power parks, the roof top SPVs reduce such risks even further.

This report indicates that all the conventional power plants technologies (coal, gas, hydro, nuclear), because of the large individual sizes, and because of the dependence on water and fuel transportation are most likely to face severe risks in the form of increased water temperature & availability, and floods. Of course due to the very need to connect such sources to complex T&D network there will be additional risks associated with the damages to T&D network.

Keeping in view that the transmission and distribution networks face credible risks from rise in atmospheric temp., floods and strong winds the distributed type of roof top solar PV systems are likely to be the most suitable electricity sources for residences and other smaller applications.

This scenario coincides with the bleak outlook forecast for the conventional power sources in future due to fast depleting fuels, need for large quantity of fresh water, demand on other natural resources such as lands, GHG emissions, escalating capital and operating costs, environmental concerns etc.

More and more reports are corroborating the forecast that only

distributed type of renewable power sources can meet our electricity demands in future on a sustainable basis. The considerations of Global Warming / Climate Change, as explicitly analysed by ADB report, can be seen as driving home the point without any uncertainties.

Reference Materials

"Bureau of Energy Efficiency": http://www.beeindia.in/

"Agenda for 18th EPS":
http://www.cea.nic.in/reports/planning/dmlf/venue_agenda_2nd_meeting.pdf

"National Electricity Policy":
http://www.cea.nic.in/reports/national_elec_policy.pdf

Chapter 11

Power sector scenario by 2032 & beyond

– towards a sustainable future

Chapter Summary

An objective analysis of the true demand and the huge potential available with renewable energy sources can clearly indicate that the reliance on conventional energy sources can be drastically reduced by 2032, and can even be completely eliminated by 2050. What is needed is the required level of commitment, a holistic approach, and detailed analysis of the demand and potential for renewables in each of the small geographic areas such as revenue districts/talukas.

Due to the fast changing conditions and preferences of usage while looking at the electricity scenario in future, it is better to consider the correct approach and action plans leading to desired outcome, than focusing on exact numbers or fine details. In this context, this chapter focuses on the approach than giving undue importance to the numbers such as MW of demand or MW of installed capacity. The objective is to identify the power sources, relevant technology and related issues to meet the electricity demand in 2032 (a year targeted by IEP in 2006). Whether the actual electricity demand in Year 2032 will be 962,000 MW (or 1207,000 MW) as projected by MoP; or 778,000 MW (or 960,000 MW) as projected by IEP; or 392,000 MW or 280,000 MW as projected by the author should not be as important as the need to identify and deploy suitable power sources with adequate potential to meet the legitimate electricity demand satisfactorily. Our focus now should be to start moving in the correct direction of an era of responsible power management from the overall perspective of society (and of course environment). Hence the MW figure mentioned in this chapter should be taken only as indicative, and to suggest the order of magnitude, because no one can really determine the actual demand by 2032 to a fair degree of accuracy. However, in all such discussions it is critically important that all possible measures should be taken to restrict the integrated network demand for legitimate purposes only, and that most efficient and responsible usage are adopted diligently.

The first step in visualizing the power sector scenario for the future (whether it is for 2032 or 2050) is to project a credible electricity demand on the integrated grid. In this regard instead of adapting the GDP maximizing paradigm to estimate energy demand, it is crucial to try to estimate what is the least amount of electricity needed to wipe out the poverty, and how best to meet it in a sustainable manner

Three scenarios for the demand and supply of electricity for the future are considered in this book, and recommendations made as to how to make those scenarios to be people friendly and environmental friendly. The details such as how, at what cost, and when should be left to a time nearer to the actual year. All that is attempted here is to make use of the information, knowledge and experience of power sector in the country and elsewhere to suggest a model for consideration by the society so that appropriate steps are taken urgently to move in that direction. IEP itself has considered eleven different scenarios without worrying too much about the cost estimations.

11.1 Scenario A: Suggested Break up of Projected Installed Capacity (MW) by 2031-32:

In this scenario (Table 19) it is assumed that the STATE and the society would accept the dire need to reduce the reliance on fossil fuels and to gradually replace them with renewables; but without considerable efficiency improvements in the existing electricity infrastructure. IEP's capacity projection of 700, 000 MW (on the basis of 8% GDP growth rate) is compared with 392,000 MW as projected by the author (on the basis of 4% CAGR of demand) as a case study.

Assumptions:

- Coal power: Only a marginal increase in the total capacity is assumed to be added, mostly to replace the old and inefficient coal power plants through UMPPs. Inadequate efforts to move away from fossil fuels are also assumed.
- Hydro power: Addition of only few power plants of capacity less than 25 MW at locations of least socio-environmental impacts; and decommissioning old and unsafe stations.
- Nuclear power: No new nuclear power plant, including the one at Kudankulam (Tamil Nadu), is considered.
- Natural gas: On the assumption that K-G basin and other potential sites prove to be productive, the capacity should be ramped up as a bridging step between coal and renewables.
- Solar: Both solar CSP and solar PV panels are assumed to play a major role.
- Wind: Full potential as recommended in IEP is assumed to be realized by 2032.
- Bio-energy: Potential as recommended in IEP is assumed to be realized by 2032

Table 19: Suggested Break up of Projected Installed Capacity (MW) by 2031-32 - Scenario A *(Conscious efforts to reduce fossil fuels and to increase renewables without considerable efficiency improvements)*

	As per IEP		Author's projection		Comments
	Capacity (MW)	% of grid capacity	Capacit y (MW)	% of grid capacity	
Coal Gaseous coal	269,997 50,000	38.53 7.13	100,000	25.50	Small increase from 98,000 MW in 2011; only UMPPs to replace the old/ inefficient plants to come on bars afresh.
Hydro	150,153	21.43	40,000	10.2	Addition of only < 25 MW capacity plants; Only R-0-R plants after 2032
Nuclear	63,060	8.99	4,780	1.22	No increase from capacity in 2011; targeted to be replaced fully by 2050
Natural Gas	69,815	9.96	25,000	6.38	Depending on additional domestic availability; targeted to be replaced fully by 2050
Solar (Grid interactive large size units only)	10,000	1.43	70,000	17.85	National solar mission target of 20,000 MW by 2020 should be ramped up adequately
Solar (Roof-top isolated and Grid interactive small size units)	Nil		60,000	15.30	Huge potential to be harnessed early by policy interventions; a must for accelerated rural electrification and for T&D loss reduction
Wind	33,300	4.75	33,020	8.5	Same as projected by IEP; expected to increase share after 2032 through off-shore wind farms; potential is much higher
Bio-energy	51,200	7.31	52,000	13.26	Same as projected by IEP; mostly community based plants
Others renewables (Ocean energy and Geo-thermal)	3,137 (IGCC Pet Coke)	0.45	7,000	1.8	Nascent technologies but huge potential; likely to get better focus after 2032
Total Capacity	700,703		392,100		

11.2 Scenario B: Suggested Break up of Projected Installed Capacity (MW) by 2031-32:

In this scenario (Table 20) it is assumed that the STATE and the society would accept the urgency to reduce drastically the reliance on fossil fuels and to replace them with renewables at an accelerated pace; along with huge efficiency improvements in the existing electricity infrastructure. IEP's capacity projection of 700, 000 MW (on the basis of 8% GDP growth rate) is replaced with 280,000 MW (on the basis that the projected demand of 390,000 MW on the integrated grid, on the basis of 4% CAGR can be reduced by 30-40% by efficiency improvement measures, loss reduction techniques and DSM).

Large amounts of money being lost in inefficient power sector practices, and those spent on direct and indirect costs to the society (as during the last 6 decades) are assumed to be channeled to efficiency improvement and DSM measures, and on improving the technology of renewable energy sources. In this regard it is assumed that the Civil Society and the STATE will be convinced soon of the need, the benefits and scope of moving away from the fossil fuels. Maximum financial/economic benefits from international initiatives such as CDM and REDD are assumed to be availed of in this scenario.

Assumptions:

- Coal power: Except for the highly efficient UMPPs, all other coal power plants are retired by 2032.
- Hydro power: Keep and/or build only power plants of capacity less than 25 MW at locations of least socio-environmental impacts; decommission all old plants with high impacts.
- Nuclear power: Decommission all existing plants and no new construction.
- Natural gas: Decommission all existing plants and no new construction
- Solar: Both solar CSP and solar PV panels are assumed to play predominant role with more than 56% capacity.
- Wind: Full potential as recommended in IEP is assumed to be realized by 2032.
- Bio-energy: Potential as recommended in IEP is assumed to be realized by 2032
- Other renewables: Given thrust for faster technology development.

It is also assumed that the sites of old coal/gas/diesel/nuclear power pants will be used to install Solar (Grid interactive large size units) such as CSP or SPV arrays.

Table 20: Suggested Break up of Projected Installed Capacity by 2031-32 – Scenario B *(Huge efforts to shift from fossil fuels to renewables; and massive efficiency improvements)*

	Capacity (MW)	Share in total capacity by 2031-32	Comments
Coal	20,000	7.14 %	Drastically decrease capacity by retiring all sub-critical parameter and inefficient coal plants;
Hydro	10,000	3.6 %	Decommission all old plants with high impacts
Nuclear	0	0	Decommission all existing plants and no new construction
Natural Gas	0	0	Decommission all existing plants and no new construction
Solar (Grid interactive large size units only)	80,000	28.6 %	National solar mission target of 20,000 MW by 2020 should be ramped up adequately
Solar (Roof-top isolated and Grid interactive small size units)	80,000	28.6 %	Huge potential to be harnessed early by policy interventions; a must for accelerated rural electrification and for T&D loss reduction
Wind	30,000	10.71 %	Same as projected by IEP; expected to increase share after 2032 through off-shore wind farms; potential is much higher
Bio-mass	50,000	17.86 %	Same as projected by IEP; mostly community based plants
Other renewables (Ocean energy and Geo-thermal)	10,000	3.6 %	Nascent technologies but huge potential; given thrust for faster technology development
Total Capacity	280,000		

11.3 Annual electrical energy demand/supply scenario by 2031-32

In both these scenarios (A&B) the annual energy estimation is not done, basically because any shortfall in it can be made up by adding roof top solar PV panels OR community based bio-energy OR a hybrid of two or more of the available renewable energy resources. Unlike the conventional power plants (which are economical only in large sizes and which have long gestation periods) renewable energy resources can be deployed quickly and at local levels depending on the need. Hence priority is not given to estimate the break up of energy output from various sources. It is also estimated that due to considerable improvement in the conversion efficiency of solar PV panels and/or the load factor of small size wind turbines, by 2032, the energy output from various

renewable energy sources will be vastly more as compared to what we know today. It is safe to assume that the energy output from various renewable energy sources will not be less than that of today's technology.

If, as suggested earlier, adequate initiatives are taken to transfer most of the smaller loads such as lighting, computers, small domestic and commercial appliances etc. to roof top solar PV panels, the management of electrical energy becomes much simpler. With appropriate tariff policies the cost to the end consumers from these distributed/roof top sources can be shown to be less than that from the interconnected grid. Over a period of time such distributed source applications can become very popular (as in the case of cell phones).

In this context annual electrical energy demand/supply may not be a complex issue.

11.4 Power sector scenario beyond 2031-32

Keeping all the discussions in the earlier chapters in objective consideration, a scenario for the long term (say by Year 2050 and beyond) can be visualised. Though the economic constraints, international machinations, domestic politics, corporate greed etc. may not allow the adoption of best action plan from the perspective of social and environmental wellbeing of our society, it is nevertheless essential to identify the major elements of such an ideal action plan, so that some honest efforts are made in that direction.

- Electricity demand growth shall be governed by diligent use of electricity for strictly economic and legitimate welfare uses only; wastages shall be heavily discouraged;
- Every power plant shall be built/operated at most optimal level of efficiency and with highest possible responsibility to the environment;
- Fossil fuel power plants, including nuclear power plants, shall be completely eliminated between 2030 and 2050;
- A substantial percentage of the energy sources are expected to be distributed type such as roof top solar and community based bio-mass plants OR hybrids of wind/solar/bio-mass;
- The concerns on the non-firm nature of the renewables shall be addressed by installing adequate number of Solar CSPs with heat storage facility distributed widely (say one in each revenue district/taluka) so that these are available for electricity generation even after the sunlight hours. A good combination of various forms of renewable energy sources should be deployed.
- Agricultural/forest lands shall not be diverted for energy related uses;

- Efficiency at all stages of energy management shall be at international best practice levels;
- Energy tariff to each category of consumers shall reflect the true cost to the society, and shall be designed to recover the actual cost of supply to that category; it shall strongly discourage wastage and reward efficiency; vulnerable sections of the society will be provided life line energy at affordable prices but will be recovered through cross-subsidy within that category of consumers every year;
- Huge emphasis shall be given for continuous innovation in making energy sector more and more efficient, and less and less polluting;
- Every consumer of electricity shall be encouraged to generate as much of electrical energy as possible by himself through initiatives such as roof top solar or roof top hybrids or to participate in community based power plants;
- Every industrial or commercial consumer shall be encouraged/mandate to install roof top solar PV systems to meet at least the lighting energy demand;
- Suitable tariff mechanism shall be in place to encourage most of the electricity loads to be fed by solar power during day time; consequently the tariff should be high during hours after the sunset;
- Suitable feed-in-tariff mechanism for roof-top energy systems shall be a common market tool to encourage local level energy production.
- CBA will be deployed as a mandatory and effective tool to eliminate inefficient and costly energy sources; and to take into account all the costs to the society.
- Old hydel power plants with dams will be dismantled carefully after adequate consultation with all stake holders to allow free flow of water in the river. In order to make up for the loss of power from these hydel power plants, suitable mix of renewable energy sources shall be deployed.

What is clear from all these discussions is that certainly there are techno-economically viable means of satisfactorily meeting the legitimate demand for electricity without having to deploy additional conventional capacity on a massive scale, as projected by IEP. The effective demand on the electricity grid at present can be brought down considerably by time tested methodologies at a much lower overall cost to the society. Effective deployment of renewable energy sources can gradually reduce the reliance on conventional energy sources.

11.5 Capital and operating cost issues

In these discussions on the future scenario the costs issues have not been dealt deliberately for a number of reasons: (i) it is almost impossible to project the actual cost of any technology to any

degree of accuracy 20-25 years hence; (ii) while it looks certain that the cost of renewable energy sources will keep going down for the next few years, the cost of conventional energy sources will keep going up basically because of the difficulty in obtaining the fuels and also because various externalities will be required to be factored in; (iii) in comparison to the total costs to the society of conventional energy sources, the costs of renewable energy sources will be much less because of many reasons discussed in the earlier chapters. In the Indian context it will be very useful to study the situation of Germany, which has less Solar energy potential as compared to India.

Germany and Holland (which also is known to have put a lot of efforts in popularizing the renewable energy sources), should be objective lessons for India in resolutely moving towards renewable energy based life style. Very frequently there have been news items about the plunging prices of solar power. There is a view that the world may not need any more subsidies for solar by 2020. Being a tropical country with huge potential, if India makes concerted efforts to deploy the solar PV panels widely, the effective costs of solar power will reduce drastically. It seems reasonable to make similar projections in the case of wind and bio-energy sources.

Reuters News Analysis (Feb. 1 2012):
http://www.reuters.com/article/2012/02/01/climate-solar-prices-idUSL5E8CV3LT20120201
“Germany is the biggest market for solar power despite its heavy clouds and northern latitude. A robust legal framework that forces utilities to buy solar power at above-market rates has more than negated these disadvantages, turning Germany into the world's top testing ground for photovoltaic energy.
Yet due to plunging prices for components, solar power prices in Germany have been halved in the last five years and solar now generates electricity at levels only a few cents above what consumers pay. The subsidies will disappear entirely within a few years, the German BSW solar association says, when solar will be as cheap as conventional fossil fuels. Germany has added 14,000 megawatts capacity in the last two years alone and now has 24,000 MW in total - enough green electricity to meet nearly 4 percent of the country's power demand. That is expected to rise to 10 percent by 2020. Germany now has almost 10 times more installed capacity than the United States.

Germany's government-mandated "feed-in tariff" (FIT) is the engine of growth. The FIT is the guaranteed fee utilities are obligated to pay a million producers of solar power for a period of 20 years. It fell to 24 euro cents per kWh for new plants in 2012 from 57 cents in 2004. Since 2010 semi-annual cuts in the incentives have accelerated, dropping the FIT from 43 cents. Germany will hit grid power parity next year -- three years faster than thought.”

In this context it is perplexing that IEP has ignored the related issues and projected a massive increase to additional conventional capacity by 2031-32 at enormous cost (not quantified though) to the society. The tiny sections of the society, which are likely to benefit most from such projection, can only be the private corporations, but all the costs will be borne by the society. There is an inescapable need for the government to objectively review the energy policy as enunciated in IEP through effective consultation with the civil society, and to come up with the necessary action plans to protect the interests of the weaker sections, the bio-diversity and the environment.

Chapter 12

Power Infrastructure for the Future

– a sector of efficiency and responsibility

Chapter Summary

There can be no doubt that the future infrastructure of the power sector must be much more efficient, professionally managed, and accountable to the public. Undue political interference will be negligible; the focus will be on the legitimate requirements of the different categories of consumers and also of protecting the environment. Regulatory agencies will be forced to be much more independent and professional too. Public's participation in all the major affairs of the sector will be much more.

An objective consideration of myriad problems with the existing electricity infrastructure, with large size centralised conventional power plants at the centre, and the network of transmission lines, substations, distribution lines and transformers etc., may make it obvious that the characteristics of future electricity infrastructure have to be different. It is reasonable to assume that in view of the need to do away with conventional power technologies, and the scope for a large number of distributed energy sources spread all over the country, the investment in the integrated power network could shift from transmission segment to the distribution segment, though the importance of any of the segments may not diminish greatly.

In the context of the social, environmental and economic issues being faced by our communities despite/because of huge investments in the power sector, it is desirable to consider how the power infrastructure should be in the future. It seems reasonable to assume that due to various factors associated with economic, social and environmental reasons, the Civil Society will exert adequate pressure on the electricity companies of the future to be highly efficient, responsible, and law abiding. These companies are also expected to be aiming to be amongst the best in the world. They are expected to be free from undue political interference and are managed through adequate professionalism.

12.1 Power Generating System/Systems

If, as envisioned in this book, the society goes for a large number of small size roof top SPVs OR wind turbines OR community based

bio-energy/CSP type solar power plants the need for a stronger integrated grid will increase, but the nature of the grid may be different.

It is difficult to visualize large size power plants by Year 2050/2075, whether they are Solar based OR Wind base OR Bio-energy based. Large capacity power plants (say beyond 50 MW) are most likely to be in very small number, if at all they exist. Most of the electricity in the system is likely to come from a huge number of small size roof top SPVs OR wind turbines OR community based bio-energy/CSP type solar power plants. If sites of off-shore wind turbines and large size geo-thermal sites become feasible some EHV lines may become necessary, but otherwise the emphasis is likely to be on strong and reliable distribution systems.

In order to supplement the large number of power output from small size roof top/community based renewable energy systems, most of which may not be able to generate power when there is no sun light, CSP type solar power plants with heat storage facility for night time power generation, OR wind turbines, OR large size bio-energy plants can be expected to be installed in each district/talukas. It seems reasonable to expect that most of the loads in the future, except heavy loads like industrial, railway traction, construction sites etc., are likely to be fed by decentralized generation sources.

Most of the power produced in these small size roof top SPVs OR wind turbines OR community based bio-energy/CSP type solar power plants will be expected to be consumed locally.

12.2 Power Transmission Systems and sub-stations

Instead of the need for more of EHV and UHV transmission corridors transferring large chunks of power over hundreds/thousands of kM, the grid of the future is expected to be strong and reliable at lower voltage levels, and may be basically designed to connect a large number of mini/micro grids. Since most of the power produced in the large number of small size roof top SPVs OR wind turbines OR community based bio-energy/CSP type solar power plants is expected to be consumed locally, only a small excess may need to be transferred between such plants OR between mini/micro grids. Hence, instead of 220/400/765 kV or HV DC links at which the exchange of large amounts of power is taking place, it is likely that predominant percentage of such exchanges takes place within a revenue taluka or district at 11 kV or 33 kV.

The need for additional high voltage lines may be small and may be needed just to evacuate power from the clusters of renewable

energy sources from remote Himalayan mountain/Rajasthan desert areas/off shore wind turbines. It seems reasonable to assume that more emphasis will be given to make the integrated power grid by the Year 2050/2075 to be stronger and reliable at the distribution level voltages than it is now, and the concept of Smart Grid will get high priority.

Instead of the need for huge investments in EHV/UHV lines, HVDC lines, Back to Back HVDC stations, sub-stations, capacitor banks, reactors, SVCs (for voltage management), pumped storage plants (for peak power management), etc. much of the future investment can be expected to be in strengthening the distribution system where much of the power will be handled. In view of the need for exporting excess power from small sources such as roof top solar PV panels, smart and reliable metering, advanced control and communication systems at distribution levels are likely to be a reality.

Due to heavy pressure for lands in urban areas underground sub-stations and gas insulated sub-stations, which require much less land area can be expected to become a norm. Unmanned sub-stations (already popular in many countries) also can be expected.

In such a Smart Grid, the demand/supply of electricity at individual consumer level can be expected to be monitored and controlled much more accurately from remote locations (such as area/state load dispatch centres) through the automated usage of advanced communication and control mechanisms. One obvious advantage of such a Smart Grid will be to the end consumers, because a Smart Grid must be highly reliable in its service availability and in various parameters such as voltage and harmonics.

Reduced need for additional transmission lines at EHV/UHV level and HVDC lines can also be expected, because of the huge problems being faced in getting the right of way for such lines and substations. Two examples can drive home this point better. The 10,000 MW nuclear power project proposal at Jaitapur, in Konkan Maharastra, may need 5 or 6 of 765 kV Class or equivalent lines to evacuate the power from that plant, if it gets commissioned. Such a transmission corridor (of about 300 meters width) for hundreds of kM of distance will demand felling of a large number of trees, which will be opposed by many agencies and the civil society. The narrow corridor of Indian territory available between North East and mainland India (called Chicken neck corridor) is being seen as a big constraint, if the so called huge hydro potential of the North Eastern states (estimated to be more than 50,000 MW) is to be harnessed fully. A recent example of how a 400 KV transmission line proposed between Karnataka and Kerala was stopped because the people in hilly district of Coorg in Karnataka are heavily

opposing the same can indicate the seriousness of the problems associated with future HV/EHV/UHV transmission corridors.

12.3 Power Distribution Systems

The distribution system (at voltages at 33 KV and below) is likely to get maximum focus in the future as compared to the priority given to EHV/UHV systems now. In view of large number of small size RE systems, and mini/micro grids, the distribution system will have to discharge a very critical role in maintaining the stability of the network in connecting a large number of different power sources and in ensuring continuous supply. In order to minimise the distribution losses the distribution companies may be expected to have high ratio of 11 kV to LT lines, and pole mounted distribution transformers of appropriate size to cater to the requirements of individual consumers. High Voltage Distribution Systems (HVDS) are already in practice in places like Delhi to avoid unauthorized use of grid electricity. Each such mini/micro grid can be expected to become parts of larger Smart Grids. The reliability of supply to individual consumers can be expected to be of very high order, because of the need to keep connectivity to individual generators who may supply the excess electricity to the grid.

12.4 Electricity Companies of the future - public's expectations

It is natural to expect the Electricity Companies of the future to be highly efficient, accountable to the public and socially/environmentally responsible. It makes sense to list the some of the major expectations of the public from these companies.

12.4.1 Generating companies:

- Are all the existing generating units OR generating stations producing electricity at maximum efficiency and lowest possible cost to the society?
- Has the company's financial management been satisfactory without seeking financial support from the government?
- Have there been studies to compare the performance of each of the generating unit with the best in the industry, and whether improvements are being implemented on a continuous basis?
- What sort of agreement it has with the local Transmission Company for the supply of MVAR? Such an agreement helps in obtaining remunerative price for the additional MVAR it may be asked to generate more than that is technically necessary.
- What are its plans to harness the renewable energy sources? If there are any impediments in doing so, what actions have been taken to overcome them?

- Has the company been in full compliance of environmental regulations?

12.4.2 Transmission companies:

- Whether the system losses are comparable to the industry standards, and how does it compare internationally?
- Is it financially sound?
- How often is the network optimization study carried out, and whether all the feasible recommendations from it are implemented earnestly?
- Before embarking upon new lines or higher system voltage, whether all other options like existing transmission corridor up-gradation or the system improvement have been explored and implemented to the extent possible?
- What commitment does it give to the public to reduce the transmission losses to the international standards?
- What is the service standard assurance given to its customers? What are the targets for achievement as far as SAIFI, SAIDI, CAIDI are concerned?
    - SAIFI (System Average Interruption Frequency Index), gives an indication of the number of interruptions for a given period averaged out at the grid level. This can be measured at the sub-station level to effectively determine its reliability.
    - SAIDI (System Average Interruption Duration Index), gives an indication of the average duration of interruptions for a given period averaged out at the grid level. This too can be measured at the sub-station level to effectively determine its reliability.
    - CAIDI (Customer Average Interruption Duration Index), gives an indication of the average duration of interruptions per customer for a given period averaged out. This too can be measured at the sub-station level to effectively determine its reliability, and to compare it with the performance of other stations.

12.4.3 Distribution companies:

- Whether the distribution losses are comparable to the industry standards, and how does it compare internationally?
- What is the service standard assurance given to the customers? What are the targets and actual performance in SAIFI, SAIDI, and CAIDI?
- What are the penalties for inadequate quality of supply as far as voltage and harmonic contents are concerned?
- What is the compensation paid to the consumers if the supply interruption extends beyond a target, under normal circumstances?

- What sort of agreement it has with Transmission Company for the supply of MVAR?
- Whether the tariff sought for different categories of consumers is sustainable to achieve fair return on the investment, protect the weaker sections of the society, encourages energy efficiency, and avoids wastage?
- What commitment does it give to the public to reduce the distribution losses to the international standards, and to minimize the overall cost of supply?
- What are its plans to ensure that the VAR requirements of the individual loads are met at the load itself? Such an arrangement reduces the distribution losses by a considerable extent.
- What are its plans to make the distribution system, including the LT lines and transformer centers, safe to the public and its own staff at a level acceptable to the industry? Are there any plans to get peer review of its safety procedures?
- What process has it in place to receive and address the public complaints? What is the minimum and maximum time frame needed to attend to typical complaints under normal circumstances ?
- What is its commitment to provide adequate electricity of high quality to everyone in its license area? What initiatives are in place to have access for adequate quantity of electricity in future?
- How easy is it for its customers to pay the bills, lodge complaints, apply for new connections, or to get any of their complaints addressed?

12.5 The urgent need for realistic pricing of Electricity

Appropriate pricing of electricity supplied to the end consumers is one of the most critical aspects of a sustainable demand/supply scenario. Without pricing the delivered electricity scientifically, and without ensuring complete recovery of the costs, the power sector can never be sustainable, as the experience has already indicated. Appropriate pricing of electricity will go a long way in reducing the wastages and in bringing in the much needed efficiency at all levels. The recurring losses of the electricity supply companies amounting to more than Rs. 100,000 Crores each year is the direct result of the failure of the STATE to implement this fundamental aspect of commerce.

To enable this scenario to emerge it is essential to determine the true cost of supplying electricity to each category of consumers, which in turn depends on determining all the costs (direct and indirect) to the society. Any subsidy to any deserving group of consumers should be so targeted and so determined on a scientific

basis that any wastage or non-essential or non-economic usage of electricity will be kept at the minimum level. Such a subsidy should be made available to the targeted consumers directly without building it into the tariff structure itself. This way the real cost to the society will not be hidden.

All efforts should be made to recover the true cost of electricity from each consumer, though the government may help targeted beneficiaries through subsidies. Irrespective of whether subsidy is admissible or not accurate metering at the premises of each consumer should be ensured without exception.

12.6 Energy Service Companies (ESCOs)

Energy Service Companies can be expected to play a major role in advising or providing the required service, wherein different options to meet the demand for additional power can be considered. These options may include energy efficiency, reduction of losses, renewable energy sources, energy auditing etc. For example, a state govt. may call for tenders from ESCOs to provide say additional 500 MW. ESCOs may offer to supply this power through one or more of the above mentioned options. Instead of working on the only option of setting up an additional power plant, ESCOs may provide much better options. These ESCOs can be expected to bring in different paradigm in the approach to meet the ever growing demand for electricity from different categories of consumers.

12.7 Electricity Regulatory Commissions (ERCs)

When ERCs started functioning about 14 years ago, there were high expectations that they can play a critical role in turning around the performance of the power sector. Some people even thought them to be a panacea for all the ills of the sector. With sadness one has to admit now that such expectations have been belied. Public's participation is generally poor, which may indicate that either the public are not aware of the role of ERCs or the public's confidence in ERCs is not as high as could be expected. Even those who were strong advocates of the role of ERCs in the initial stages seem to be loosing confidence in the functioning environment of ERCs to effectively participate in the business of ERCs.

The general perception is that the state governments have not created an environment wherein the ERCs can function independently and professionally. It is difficult to notice any discernible influence of ERCs on electricity companies so far as the service delivery to the consumers and in financial health of the companies is concerned.

However, in future ERCs will be required to play much more effective role than at present in bringing high efficiency, service

accountability, financial prudence, environmental compliance etc. The tariff revision process can be expected to be much more transparent with active public participation to satisfy the legitimate expectation of various categories of consumers. Much more interaction with the public can be expected to bring in the desired results. ERCs can be expected to be much more professional in implementing the relevant Acts and regulations to keep the entire power sector highly responsible. ERCs will be expected to be much more independent of the state/central government influence in their operations, and become highly accountable to the public in a transparent way.

12.8 Public participation towards inclusive growth

In view of the multi-dimensional crises facing the electrical power sector the Civil Society has to take a higher profile to work concertedly with the state and union governments, as compared to negligible participation in decision making processes at present.

- An appropriately empowered committee at the state/center, such as a task force or a standing committee of the Civil Society representatives, should effectively review the past and present practices in electrical power sector, and to form policies for the future which are people friendly, environmentally friendly and sustainable. The Global Warming potential of the power sector; the reports of IPCC; limits of the nature; and ongoing efforts by UNFCCC have to be kept at the centre of focus while undertaking such review. This process must take various stake holders into confidence by suitable steps such as effective public consultations at every state, as was done in the case of decision on Bt. Brinjal.
- The legitimate demand for electricity and the true rate of growth of electricity demand should be identified keeping in view the real developmental needs of all sections of the society, and the limit of the nature in supporting such escalating demand. All steps needed to keep such a demand within the limits of our natural resources should be implemented such that true development is not hindered.
- Highest priority should be provided to optimally utilise each of the existing electricity infrastructure facilities in the country. An objective comparison with international best practices in each segment of the power sector can be used as a guiding tool.
- Before conceptualizing new large scale projects such as coal based, OR dam based OR nuclear based power projects, all the benign alternatives should be fully harnessed, and the final decision should be arrived at only after thorough review of the situation and after effective public consultation.

- The onus of establishing the real need for additional conventional projects beyond reasonable doubts should be on the project proponent. Effective public consultation in all such projects and an objective Costs and Benefits Analysis should become a mandatory part of approval process.
- All possible measures should be taken to encourage the wide spread use of small size, distributed type renewable energy sources.
- Electricity companies should be entrusted with necessary levels of freedom and appropriate level of public accountability to function efficiently and with high degree of social responsibility.
- In the event of any referendum to be held to collect public opinion on the environmental impact, such hearing shall be held by an independent judge with due regard to principles of natural justice.

Useful References

"Central Electricity Regulatory Commission": http://www.cercind.gov.in/

"Power sector reforms: a pilot study on Karnataka": http://www.indiaenvironmentportal.org.in/reports-documents/power-sector-reforms-pilot-study-karnataka

Chapter 13

A Case study on Karnataka

– in integrated resource management approach

Chapter Summary

The case study on the state of Karnataka indicates that it is typical of most other states in the Union on many aspects. An objective consideration of the state's features on geography, climate, natural resource base, demography etc. can provide a clear indication of the most suitable development pathway for the state as well as a fit model for power sector. The case study reveals that Karnataka can meet its electricity needs without having to rely on conventional power sources. This case study may also provide a methodology to develop an integrated power policy framework for other states of the union, and for many developing countries.

A case study w.r.t the state of Karnataka can illustrate how the power scenario in different states can be reformed by careful application of integrated resource management approach. A high level analysis of the ground realities of the state, its strengths, constraints and natural resources can reveal that through a responsible management of its resources the legitimate demand for electricity of all sections of the state can be met on a sustainable basis without having to compromise on its environment.

13.1 Scenario- the recent past history

The state of Karnataka (starting from the erstwhile Mysore state and its predecessors) can be considered a pioneer in the development of many areas of Electricity. Starting from one of the first hydro-electric station in Asia (at Shivanasamudra) in 1902; the then longest high voltage transmission line in the world between Shivanasamudra and Kolar (at 66 kV); the first state to promote the use of electricity in residences and agriculture in 1960s; start one of the first co-operative societies for electricity distribution in 1969, it had been a story of bold initiatives and adventurous actions. But it has also been a sad story of multiple crises for the power sector during the last few decades.

The decade of 1970s was a strange mix of surplus and heavy deficit. There was huge surplus of electricity in early 70s when the ten generators at Sharavathy Valley hydel project were being

commissioned one after the other. However since 1973 Karnataka has been experiencing power cuts continuously. While, the state is seeking massive private investment in manufacturing and services sector, the lack of adequate infrastructure, including electricity, is being quoted by the private investors and financial institutions as the main hurdle in such an investment. Even though the shortage of electricity is not unique to Karnataka, its impact is quite discernible in the state's socio-economic development. The green revolution of 60s and 70s, which made India self sufficient in food, has largely been possible because of electric pumps for agricultural purposes. If the society cannot ensure the supply of adequate and quality electricity, not only the agricultural output, but also the industrial output will be seriously affected.

Starting from a meager generating capacity of 720 KW at Shivanasamudram in 1902, its own generating capacity has increased to 10,727 MW in 2011 (an increase of about 15,000 times); its total power availability has increased to 12,731 MW (an increase of about 17,700 times).

Table 21: Available power capacity for Karnataka (MW)
(as on 30.6.2011)

State Sector (all types of fuels)	6,615
Private Sector	4,116
Share in Central Sector projects of Southern Region	2,000
Total	12,731

(Source: CEA website)

13.2 Present Scenario – chronic shortages due to inefficiency

The prevailing scenario since 1980s is one of chronic power cuts, dissatisfaction to all categories of consumers and poor financial status of the power companies. Non-availability of adequate quantity and quality of electricity is being cited as a major constraint in achieving accelerated industrialisation. In its eagerness to embark on industrialisation in an accelerated mode, the state encouraged wide spread use of electricity for domestic, irrigation and industrial purposes in 1970s. The result was the unchecked growth for the demand, and consequently unmanageable supply scenario for electricity within a decade. Since then the state has never been able to meet the electricity demand of any category of consumers satisfactorily on a continuous basis. While the gross power capacity for the state has increased by about 17,700 times, the demand has increased much more with the result there is a chronic power cuts.

As per the Karnataka State Action Plan on Climate Change (Karnataka SAPCC, draft): " For the period 2001 to 2010, electricity supply from thermal sources and non thermal sources (mainly wind and hydro) averaged at 50.8% and 49.2% respectively. Of the

non-thermal sources, hydro electricity constituted about 27% of the total energy mix in 2010. However, the generation of hydropower has shown a declining trend with a decrease of 18% between 2007 and 2009. The primary reason for this decline is the erratic trends of rainfall. This situation is expected to worsen with the changes in precipitation predicted by climate scientists, leading to non uniform water availability" [13.1].

Table 22: Available Power capacity in Karnataka as on 30.6.2011 **(MW)**

	Hydro	Thermal (Coal + diesel)	Nuclear (Share)	Renewables	Total
State's own capacity	3,600	2,348	0	667	6,615
Private Generating					
Companies	0	2,167	0	1,949	4,116
Central (NTPC & NPCIL)	0	1,805 (Share)	195	0	2,000
State Total	3,600 (28.3%)	6,320 (49.7%)	195 (1.5%)	2,616 (20.6%)	12,731

(Source: CEA Website)

It is symptomatic of the power scenario in many states of the union that despite having no coal reserve of its own, Karnataka has depended predominantly on coal power (including its share from NTPC) with about 49.7% of its available capacity coming from thermal power (coal and diesel). The state was solely dependent on hydro until 1980, but that share has come down to 28.3%. The negligible percentage of nuclear power share (1.5%) is also consistent with the scenario at the national level.

Table 23: Consumer profile in Karnataka (2009-10)

Consumer Category	IP Sets	Industries (LT+HT)	Domestic lighting & AEH	Commercial & public lighting	Others
Energy consumed (MU)	11,772	8, 298	7,360	5,040	1,220
% of total energy sold	35	24.6	22	15	3.4

(Source: Karnataka SAPCC)

Agriculture (35%), industries (25%), and domestic (22%) consumers account for 82% of the total electricity consumption in the state. It is also important to note that the lighting application itself account for about 20% of the total consumption. This consumer profile itself, when viewed in the context of gross inefficiency prevailing in the power sector of the state (which is also symptomatic of the scenario at the national level) can clearly indicate the way ahead to overcome the power cuts. Though T&D losses in the state is said to have come

down from 38% in 1999 00 to 22% in 2009 10, it is likely to be much higher (than 22% figure quoted) as indicated by the low voltage profile noticed at different parts of the state, and also the belief that the distribution companies may be showing some of these losses under IP set category.

The demand and supply scenario also is similar to that of the national scenario with the deficit during the peak hours of the day being recorded higher than the annual energy for most of the years.

Table 24: Typical Electricity Demand, supply and shortage in Karnataka (Year 2003 to 2008)

	2003-04	2004-05	2005-06	2006-07	2007-08
PEAK POWER					
Requirement (MW)	6213	5927	5949	6253	6583
Availability (MW)	5445	5612	5558	5811	5567
Shortage (%)	12.4	5.3	6.6	7.1	15.4
ANNUAL ENERGY					
Requirement (MU)	36,153	35,156	34,601	40,797	40,320
Availability (MU)	31,145	33,687	34,349	39,948	39,230
Shortage (%)	13.9	4.2	0.7	2.1	2.7

(Source: CEA *Website* as on 21.10.08)

As is the case elsewhere in the country, the state has been suffering power cuts and plethora of associated problems due to gross inefficiency in the sector. A quick overview of the available power production capacity and the actual maximum power demand met in a year indicates the source of the problems. Table 25 indicates that though the net power capacity available for the state, after allowing for the station auxiliary consumption and unplanned outages (as per norms of CEA), should have been about 11,500 MW, the actual peak demand met during April-December 2011 was only 7,650 MW. This unexplained gap of about 3,900 MW (even if it is only 2,000 MW) can be only due to inefficiency in the overall sectoral management.

Table 25: Net power availability for Karnataka as on 30.6.2011 **(MW)**

	Installed Capacity {A}	Aux. consumption @ 10 % for thermal; @2 % for hydro & renewables {B}	Unplanned Outage @ 5% {C}	Net capacity Available for use {A-B-C}
Thermal	4,515	452	223	3,840
Hydro	3,600	72	180	3,348
Central sector share	2,000 (assumed)	Not applicable	63	1,937
Renewables	2,616	52	131	2,433
Total	12,731			11,558 (Actual max. demand met was only 7,650 MW)

(Source: Estimation by author as per *CEA* norms)

13.3 Strengths and constraints – natural resource base issues

Whereas the state is considered to be lucky in many aspects of its geographical/climate aspects, such as Western Ghats (WGs), a beautiful coastline, and salubrious climate in many places etc. it also faces some severe constraints, which can exacerbate the projected impacts of Climate Change. The statistical figures/salient features mentioned in the draft action plan, if considered from an objective perspective, should be able to provide the critical elements of a credible Climate Action Plan, and hence an appropriate power sector policy.

On the basis of discussions in 'Karnataka State Action Plan on Climate Change (Karnataka SAPCC, draft)' and 'An effective Climate Action Plan for Karnataka: Comments on State's official draft Climate Action Plan'[13.2], the following salient features of the state can be listed.

- About 77% of the total geographical area of the state is arid or semi arid; 54% of total geographical area of the state is drought prone as two thirds of the state receives less than 750 mm rainfall per annum. Karnataka ranks second in India, next only to Rajasthan, in terms of total geographical area prone to drought. Global Warming is projected to severely impact tropical areas. Hence the drought prone characteristics of the sate should be a crucial consideration for any developmental plan for the state.
- The state is endowed with limited water resources that are already stressed and fast depleting. Water resources are officially considered to be under severe threat in Karnataka. The sectoral demands for water and electricity are growing rapidly on account of increase in population, urbanization, rapid industrialization and rising incomes. This fact too should be a crucial consideration in Climate Action Plan.
- 64.6% of the total geographical area of the state is under cultivation; and farmers and agricultural laborers account to 56.5% of the total workforce of Karnataka. The state experiences rich and diverse agriculture practices which contribute 28.61% to the Gross State Domestic Product (GSDP). This should be seen as a rich tradition to preserve and enhance.
- Karnataka is the largest producer of coffee, raw silk, sandalwood, ragi, sunflower, tomato, coffee, areca nut, spices, aromatic and medicinal plants, and second largest producer of maize, sunflower, grapes, pomegranate and onion. Horticultural crops contribute to over 40% of total income generated from agriculture. In floricultural production, Karnataka occupies second position in India. These are great strengths from the perspective of minimizing the impacts of Global Warming.

- The state of Karnataka, with its urban population at 34% of total population, is currently ranked as the fifth most urbanized state among all. Increasing urbanization, which is contributing hugely to Global Warming and power demand, demands a thorough review of the related policies.
- With 19.96% forest cover and with Western Ghats as one of the 18 Global bio-diversity hotspots, the state has an important role to play as a carbon sink at the global level.
- Electricity (35.9%); industry (22.5%); agriculture (20.2%); and transport (10.4%) are the major contributors of GHG emissions in the state. GHG emission from state coal power sector has almost doubled from 2006 07 to 2010 2011. Further, CO2 emission from private coal power combustion has increased many folds between 2006 07 and 2010 11.
- The industrial sector is also a large contributor of GHG emissions as well as largest consumers of electricity in the state.
- The services sector dominates the state economy, the tertiary sector contributing about 55% to GDSP in recent years. The contribution of secondary sector and primary sector are about 29% and 16% respectively. Since manufacturing/industries contribute hugely to the GHG emissions, the services sector which demands much lower quantum of energy and which generally has a much smaller carbon foot print should be priority focus for employment generation/ wealth creation.
- Karnataka has no known reserves of coal or petroleum products. Hence this prominence of fossil fuels in its energy mix, which also lead to high GHG emissions, needs a thorough review.
- Karnataka ranks seventh in the production of cement in the country. Karnataka is also the third largest steel producer in India. These two industries account for over 20% of the overall emissions of the state and over 40% of the emissions due from industrial sector.
- Most of the industries in Karnataka, being small scale industries, do not meet current energy efficiency standards, thus pose a greater threat to the already scarce energy resources.
- Karnataka's overall energy intensity has been estimated at 521.11 toe/$ mn, which is lower than the national average. The energy intensity of the state has dropped by 25.2% since the 1990s, which is attributed to the expansion of services sector in the structure of Karnataka's economy.
- Demand for electricity in Karnataka is likely to grow by 55.8% in the next 6 years from the present 44.71 billion units to 80 billion units in 2016 17 as per the 17th Electric Power Survey report.
- As per Karnataka SAPCC (draft), the state's potential in Renewable energy sources is about 28,700 MW (only medium and large size capacity suitable for grid connection) of which

only about 3,000 MW of installed capacity has been commissioned so far.

- Climate change presents severe risk to human health in numerous ways. Hence any investment in minimizing such risks is worth considering.

A decent analysis of these ground realities of the state can provide a sustainable developmental framework and future power demand/supply scenario for the state.

13.4 Brief Analysis of ground realities

The state's stressed and fast depleting water resources; its agrarian strength; already good industrial development and urbanisation; massive economic contribution from services sector; absence of any fossil fuel reserve, and vast potential with renewable energy resources etc. are all pointing towards a clear developmental path way and power scenario. The future developmental path can be sustainable to the welfare needs of the people only if the focus is on an economy based on agriculture/horticulture & allied services; on services sector (IT, BT, Health, Education, tourism etc.); and also focusing on conserving and expanding the forest cover. This situation, without any hesitation, also calls for heavy reliance on efficiency in all facets of the society and highly responsible usage of water and other natural resources.

Highly responsible management of limited fresh water sources through enormous emphasis on protecting the ecology of the rivers and its catchment areas, rainwater harvesting, groundwater recharging etc. will not only reduce the impact of droughts, but will also reduce the demand for grid quality electricity by a considerable margins. The presently ongoing practice of unscientific and mindless act of sand mining on river banks (and even within rivers) without least respect for the sanctity of our rivers can lead to drying up of evergreen rivers as happened to a river in Kerala. Illegal and unscientific withdrawal of water from the rivers through IP sets may be one of the reasons for water related issues and also the huge demand for electricity from agriculture sector. The need of the hour is a holistic look at all the related issues, effective discussions with the stake holders, and a long term policy of sustainable development.

These issues also indicate that the CAGR of electricity consumption/generation need not be high for the purpose of economic development. Much of the additional demand for power is likely to be for consumption without contributing greatly to the economic usage. The potential of about 28,700 MW in renewable energy sources can be harnessed effectively to meet most of the legitimate electricity needs of the state, and can provide a basis to eliminate fossil fuel based power plants, and also to minimize the

dam based hydel power plants. When the enormous amounts of solar power potential (both solar CSP and roof top solar PV panels) is viewed in the background of the vast scope for efficiency improvement in the existing electricity infrastructure, the inappropriateness and dangers of continuing to build coal based/dam based/nuclear power plants in the state becomes glaring.

As per the 'expert group on low carbon strategies for inclusive growth', the emission intensity at the national level as expressed in grams of CO2 -eq per Rs. of GDP has fallen from 66.8 in 1994 to 56.21 in 2007, indicating the impact of government policies that encourage energy efficiency in various sectors of the economy. The report also indicates that aggressive efforts in bringing optimum energy efficiency to domestic and commercial appliances can save about 150 Billion kWH by 2020 at the national level. Hence the highest possible levels of energy efficiency at all stage of generation, transportation and utlisation at the state level also is critical for minimizing the future electricity demand.

13.5 Difficulties faced by conventional power projects

The two coal power projects at Raichur and Bellary (North Karnataka) have been facing highly unreliable coal supply problems in recent years. Raichur power plant with 8 generators has rarely operated to its full capacity in recent years due to multiple problems. Fresh water supply has been a perennial problem to the people of the northern part of Karnataka, where these plants are located, and where many more are proposed.

Large size conventional power plants are also facing stiff opposition from the locals and the environmentalists. Power project proposals, which have been abandoned due to opposition from the public, are: Bedthi Hydel project, Tadadi UMPP, Hanukon Coal power plant, Chamalapura coal power plant. A report from Western Ghats Expert Ecology Panel (WGEEP, constituted by MoEF) is reported to have recommended (Aug. 2011) the denial of environment clearance for Gundia hydel power project in Western Ghats of the state, and also to declare the entire Western Ghats as environmentally sensitive, because of which the establishment of additional large size power projects (both conventional and non-conventional) will be very difficult. One coal power plant near Udupi in coastal Karnataka is facing continuous opposition from the locals and the environmentalists despite the fact that the first generator has been operating for about a year.

Despite all these well known problems more than 15,000 MW of coal based additional power plants have been proposed to be set up in the state, and the state government is reported to be actively

pursuing with the coal ministry to allocate the required amounts of coal and natural gas for these projects. It seems evident that all the associated issues such as assured coal supply, land acquisition, fresh water requirement, massive opposition from the locals, the potential impacts on the bio-diversity hot spot of Western Ghats, Global Warming potential, absence of diligent system studies, the overall costs to the society etc. have not been considered objectively.

In view of the recommendation in the report by WGEEP to declare Western Ghats as eco-sensitive, it is hard to imagine that any more dam based power projects can be set up in the state.

The Chief Minister of Karnataka was reported to have said some time ago that since setting up a coal power plant in Karnataka is not economical, a coal power plant for the use of Karnataka was being set up in Chhattisgarh. It is a sad commentary on the approach of our decision makers that despite such clear acknowledgement of the cost of setting up a coal power plant in the state, many more coal power plants are being proposed.

A high level discussion on the costs and benefits to the state of a proposed 4,000 MW coal power plant by NTPC is indicated in Annexure 10.

Despite people's opposition one nuclear power project was commissioned in the state (4 nuclear reactors at Kaiga in costal Karnataka) about 10 years ago, and is now seeking to add two more units for which opposition is being reported in the media. In this context the state cannot hope to add many conventional power plants without incurring huge social, economic and environmental costs.

13.6 Huge relevance of renewable energy sources

In order to meet the future electricity needs of the state, a different approach is considered essential. A high level estimate indicates that if on average 1,000 Sq, ft of roof top in each of the 20% of the total households in the state (those houses which are structurally and economically strong) are used to set up solar photo voltaic panels a total solar power capacity of about 20,000 MW can be achieved with virtually nil GHG emission addition, nil water requirement and nil displacements of people. Such roof top solar photo voltaic panels will drastically reduce the energy lost in transmission and distribution, and if connected to the existing grid network can eliminate the need for additional conventional power plants. If the roof tops of various types of other buildings in the state such as schools, colleges, industries, offices, ware house etc. also are effectively used the total solar capacity which can be realized will be mind boggling.

Through the 'feed-in-tariff' mechanism, if the excess electricity produced in such roof top solar PV installations is fed back to the grid through the existing distribution network, the power scenario of the state can undergo a complete transformation towards a sustainable model. Solar CSPs with heat storing provision along with wind turbine and bio-energy potential can conceivably meet most of the electricity demand during off-day light hours. Highest possible efficiency measures in the power sector and careful management of the power demand will make such a scenario even more attractive.

In view of the externalities associated with the conventional policies, the total cost to the society of an approach based on RE sources will be many times lower than through an approach of adding conventional power projects. The policy makers of the state has been advised of the need for such an approach since many years but there have been no changes despite experiencing chronic power cuts.

13.7 Integrated energy resource management approach for the state

Author's presentation on "Power Sector Reforms in Karnataka" at a seminar organized by the State Planning Board on 4 & 5, May 2007 at Bangalore ('Seminar on Eleventh Five Year Plan of Karnataka: Perspectives') has provided a high level analysis of how the power demand /supply model in the state can be in the future to meet the electricity demand satisfactorily without being termed as anti-people and anti-environment [13.3].

This model indicates that the peak hour demand of the Karnataka's Electricity Grid can be reduced from the projected level of about 9,281 MW in Year 2018 to less than 4,500 MW by effectively deploying various alternatives such as T&D loss reduction, efficiency improvement in end usage in agriculture, domestic and lighting applications; a modest usage of solar, wind and biomass potential. Since the net power availability to the state at present is about 11,500 MW, there could be a situation of surplus by nearly 250% in meeting this peak hour demand. Similarly, the annual energy requirement can be reduced from the projected level of about 51,000 MU in the year 2018 to about 27,000 MU. Since the net annual energy availability is more than 45,000 MU there should be no energy gap either. What this model indicates is that without having to invest huge sums additionally on fossil fuel or dam based or nuclear power plants, the projected demand of the state by 2018 can be met comfortably. An obvious extension of this scenario is that by Year 2030 or 2040 it is credible that the state can meet the legitimate demand for electricity by all sections of the society on

Table 26: High level estimate of potential for and costs of additional sources of electricity for Karnataka in next few years

Source of additional power	Estimated Potential for savings	High level estimate of costs (as in 2006)
R, M & U	160 MW & 800 MU / year	Rs. 104 Crores (@Rs. 65 Lakh/MW, as per BBMB experience)
T&D loss reduction	1,100 MW &7,000 MU / year	Rs. 1,240 Crores (@Rs. 1.125 Crores/MW, as per BEE estimations)
Utilisation loss reduction -non-agricultural	1,100 MW & 4,300 MU / year	Rs. 1,240 Crores (@Rs. 1.125 Crores/MW, as per BEE estimations)
Utilisation loss reduction - agricultural	Nil peak demand savings and 2,500 MU energy / year	Rs. 200 Crores (@Rs. 0.75 /kWH as per BEE estimations)
Wind energy	600 MW & 2,100 MU / year (the real potential is much more)	Rs. 2,700 Crores (As per Planning Commission estimate)
Biomass	480 MW & 2,000 MU / year	Rs. 1,440 Crores (As per Planning Commission estimate); 25% of the MW benefit to come from distributed generation sources. Hence this much cost shall be borne by beneficiaries
Solar – Water heating	2,100 MW during morning Peak and 1,050 MW during Evening peak; 1,100 MU / year	Actual costs to be transferred to the end users as all of the benefits are expected to come from distributed generating sources
Solar –residential lighting	300 MW & 600 MU / year (the real potential is much more)	Rs. 750 Crores (As per Planning Commission estimate; @ Rs 25 Crores /MW). 90% of the MW benefit to come from distributed generation sources. Hence this much cost shall be borne by beneficiaries
Solar - water pumping for IP sets	300 MW & 3,200 MU energy / year (the real potential is much more)	Rs. 2,250 Crores (@Rs.30 Crore/MW, as per Planning Commission estimate) All benefits to come from distributed generation sources. 10% of the total cost in the form of subsidy and technical support cost shall borne by the society.
Solar - Public and commercial lighting	40 MW & 640 MU / year (the real potential is much more)	Rs. 750 Crores (As per Planning Commission estimate; @ Rs 25 Crores/MW). 75 % of the cost to be borne by State.

(Source: Author's own estimation on the basis of power scenario in the state)

a sustainable basis without the need for fossil fuel based or dam based or nuclear power plants. Towards this scenario the society has to proceed with determination, clarity and long term vision.

An objective consideration of the electricity scenario in the state will reveal that in reality there is no shortage of the electricity generating capacity if we can achieve international standards in the performance of the assets in generation, transmission, distribution and utilization. Hence, efficiency improvement, energy conservation, DSM, and optimum deployment of distributed renewable energy sources will not only enable us to eliminate the deficits, but also will reduce the reliance on conventional power generating sources. In the long term the scope for eliminating the conventional power sources entirely (including the nuclear power) is credible, and hence should be pursued with determination. There is huge potential for this approach to ensure much improved status in social, environmental and economical aspects of the state.

13.8 Electricity needs of rural Karnataka and arid North Karnataka

Keeping in view the huge cost to the society of extending the grid supply to the remote villages, and other customers which are away from the main trunk routes; the arid nature of the northern parts where sun light is available for 8 to 10 hours for more than 330 days in a year, and where water is a scarce resource, the huge relevance of RE sources in distributed mode becomes apparent. SPV systems at individual house hold level and CSP systems at community level can meet most of the electricity needs of the rural Karnataka, especially in the drier parts of the state. Since sun light is available for most parts of the year in the arid parts of the state, agricultural needs for electricity can be met by solar powered IP sets. This would remove the issues of unreliable power supply to the farmers, and reduces the losses on the system.

As discussed in section 7.5, DC/AC home lighting systems through SPV panels on roof tops are most suitable for the domestic power supply scenario in arid north Karnataka, but require careful planning and necessary policy interventions; and can avoid huge issues of losses and voltage variations.

Suitable investment by the society, including the state government, in these areas can only be a positive step and will bring huge benefits in the long run. The recurring financial losses running to more than thousand Crore rupees a year, chronic power cuts, and socio-economic set back being experienced in the state can be addressed only through such a holistic approach.

13.9 Application of this model to other states in the Union

Similar approach in analyzing the legitimate power demand of other states w.r.t their geographical strengths and constraints as well as the availability of natural resource will be able to provide much more efficient, responsible, people centric and environmentally friendly model for power demand/supply than what we have at present. The huge investment that is happening both in the public and private sector to add conventional power plants and to expand the transmission network can be drastically reduced and only a small portion of it may be needed to move to a sustainable power supply model. What is critical in this approach is to involve various stake holders in all the required deliberations and decision making processes.

References:

13.1: 'Karnataka State Action Plan on Climate Change (Karnataka SAPCC, draft)': http://empri.kar.nic.in/Karnataka%20SAPCC%20-%20Rapid%20Assessment%20-%20EMPRI,%202010-12-30.pdf

13.2: 'An effective Climate Action Plan for Karnataka: Comments on State's official draft Climate Action Plan' (http://mitramaadhyama.co.in/?p=2553)

13.3: "Power sector reforms: a pilot study on Karnataka": http://www.indiaenvironmentportal.org.in/reports-documents/power-sector-reforms-pilot-study-karnataka

Other useful references

Report by 'Expert group on low carbon strategies for inclusive growth' under MoEF;
http://moef.nic.in/downloads/public-information/Interim%20Report%20of%20the%20Expert%20Group.pdf

"Towards a sustainable power policy in Karnataka": http://mitramaadhyama.co.in/?p=2276

"Power Sector Inefficiency – Economic & Legal Implications": http://mitramaadhyama.co.in/?p=1763

"Electricity supply management – Lessons from Kerala": http://mitramaadhyama.co.in/?p=1765

"Impact of Electric Power Sector on Western Ghats: Issues and remedies": http://mitramaadhyama.co.in/?p=1570

Chapter 14

Action Plan for a sustainable power policy

– towards a sustainable future

A major drawback with IEP is that it did not identify suitable action plan for the power sector. A holistic review of various policies, practices and norms is urgently required if the power sector has to play the critical role in all round development of our society. Major recommendations for such a paradigm shift in the power sector are:

14.1 Vision and Mission statements

a. The vision of IEP says: "To reliably meet the (energy) demand at competitive prices". A better vision should focus on realistic price and sustainability. Such a mission statement for the power sector could be: To develop an integrated power policy to enable meeting the legitimate demand for electricity of all sections of the society at realistic prices on a sustainable basis without compromising the interest of other aspects of the society such as flora, fauna and general environment.

b. An objective consideration of welfare of all sections of the society with a definitive obligation towards the bio-diversity and environment must be the platform on which power policy should be built on;

c. The last man on the street OR the vulnerable sections of the society should be at the centre of our power policy to enable adequate human development of the entire society, instead of focusing on GDP growth centric development;

d. Power security should not be viewed as something achievable by relying on external resources; it should be almost entirely on our own resources and our own strengths;

e. In view of the huge impact on our society, including the all important environment, the use of non-renewable energy sources, such as coal, natural gas and nuclear, should be discontinued at the earliest; their usage should peak early, and gradually eliminated latest by 2050;

f. In view of the inevitability of harnessing the renewable energy sources on a sustainable basis, all out efforts should be made to develop them to meet our entire electricity needs before the middle of this century; this should include adequate focus on R&D, fiscal incentives if necessary, suitable policy interventions,

necessary regulatory measures etc.;

14.2 Electricity demand projection and DSM

g. Electricity demand should be managed in such a way that its consumption leads to real developmental/welfare activities, and not lead to plundering of our natural resources by wasteful and luxurious consumption; a clear distinction between electricity needs, wants and luxury should be arrived at by the society;

h. Electricity should not be made available at cheap rates; there cannot be any competitive rates either; it should be available only at the true cost of supply, and should be available only through the most efficient mechanism/ process operated on a sustainable basis;

i. All feasible options, including the tariff restructuring and financial incentives, available to minimize the variation in electricity demand curve in each state should be deployed, and the difference between maximum demand and average demand should be reduced to, say, 10% by 2015 in all the states; no new peak load power stations, such as pumped storage plants, should be permitted with immediate effect; Time of Day (TOD) metering with suitable tariff regime to differentiate between peak hour tariff and lean hour tariff should become compulsory for all loads above, say 10 kW by 2015. There should be an incentive to bring the consumers with lower connected load into this regime;

j. As per the mandate of IE Act 2003, energy metering must be made compulsory for each consumer, and there shall be no supply to any consumer without accurate metering beyond 2015;

k. The usage of CFL/LEDs should be fully implemented by 2015 by: (a) following the example of Maharastra, where the electricity companies are providing millions of such lamps to house holds on easy payment terms; (b) provide tax benefits/subsidy for the manufacture of CFLs/LEDs for few years, if necessary; (c) directly & indirectly discouraging the usage of incandescent lamps by levying cess on their sales; (d) by banning the sale of incandescent lamps by 2015; (e) undertake few projects under CDM to finance the subsidy on CFLs/LEDs.

l. Energy auditing should be made compulsory for all electricity consumers with a connected load of more than 10 kW by 2015 and those with a connected load of more than 5 kW by 2020.

m. Rain water harvesting in every revenue sub-division should be implemented as a major initiative in managing the demand for electricity and also for water security.

14.3 Efficiency

n. International best practice level efficiencies must be adopted at all segments of power sector; AT&C losses should be brought down below 10% in each revenue district of the country by 2020; the PLF of each coal /nuclear power project should be improved to a

minimum of 90% by 2020; efficiency of end use applications, including agricultural pump sets should be comparable with the international best practices by 2020; electricity revenue recovery rate in each state should be improved to a minimum of 95% by 2020;

o. By 2017 every coal power plant in the country with average PLF less than 80% during the previous 3 years, and/ or older than 20 years should be either be undergoing complete renovation or complete replacement by power plants with highest efficiency possible;

p. All feasible options available for increasing the capacity or to improve the efficiency of each of the existing generating stations should be explored and implemented before any new generation project proposal by any power generating company in any state is considered by the approval authority. In this regard CEA should be asked to look at each of the stations state by state, consult the original equipment manufacturers or experts to determine any such opportunity available. In such situations, the actual cost of such improvement process, however high, will turn out to be far less than the cost of building new power stations. But the contractor should provide specific guarantees and the results should be measurable and accountable. The PFC could be asked to finance the costs, and NHPC/NTPC can be asked to manage the projects;

q. Develop (if necessary, borrow the ideas already developed in advanced countries) and implement the concept of peer review of all the projects and work processes in each of the state owned electricity undertakings; effective stake holder consultations should be a part of mandatory approval process;

r. Undertake comparative studies in detail of the electricity industry performance in our country with those in developed countries; publish the Key Performance Indicators (personnel per MW handled, overall efficiency, project implementation time etc.) in those countries, and set realistic but stiff annual targets for our own industry, to be achieved by 2020 to attain a comparable level of industry efficiency;

s. Subsidized electricity to any category of consumers should be admissible only by advance payment of one year's subsidy amount by the concerned state government.

14.4 Investment, CBA and project management

t. The Central power utilities such as NTPC, NHPC, PGCIL, NPC etc. should be mandated to invest about 25% of their annual budget in modernizing the transmission and distribution system

in states so as to reduce the AT&C losses below 10% by 2020; adequate return on such investments should be ensured;

u. The Central generating agencies such as NTPC, NHPC and DVC should be encouraged to invest about 25% of their annual budget in the modernization or replacement of old and inefficient power plants in state sector, either by acquiring such assets or as an investment on easy terms;

v. Without an effective Costs and Benefits Analysis (CBA), along with a societal perspective, no new power plant proposal should be considered;

w. Most of the newly permitted coal power plants should come up on the sites of existing old/ inefficient power plants;

x. Initiate action plan to mandate effective public consultation at the stage of the application for registration itself on all large projects. All the concerned stake holders should be able to participate in such consultations, and arrive at the correct decision regarding the benefits of the project and agree on the process of comprehensive rehabilitation. All the concerned stake holders like the locals and NGO groups, should be involved from the initial stages of project conceptualization. Such pro-active action will reduce the chances of public opposition to approved projects and corresponding project completion delays;

y. The proposed ultra mega power projects of capacity 4,000 MW each in green sites are not in the overall interest of our society, and hence should not be considered further. Instead the more sensible option of considering the existing sites of older and low PLF thermal power stations should be used. Such sites should be used to install new super critical technology units of 600/800/1,000 MW capacity, and to improve the average PLF to more than 90%. If necessary, entirely new station should be considered on the old sites to reduce the need for acquisition of additional lands.

14.5 Renewable Energy

z. By 2025 atleast 25% of domestic consumers of electricity should have roof top solar or roof top hybrids for electricity generation, or should be participating effectively in community based RE power plants;

aa. By 2025 atleast 50% of industrial or commercial consumers should be encouraged/ mandated to install roof-top solar PV systems to meet the illumination needs;

bb. By 2025 atleast 50% of educational institutions and govt. buildings should be encouraged/mandated to install roof-top solar PV systems to meet the electricity demand of lighting fixtures and

other lighter loads;

cc. By 2025 atleast 25% of the villages in the country should have their own electricity supply system based on solar, wind and bio-mass sources of adequate capacity to meet most of their domestic requirements, either in isolated mode or in grid interactive mode; the longer term target should be to have not less than 75% of rural electricity requirements to be met by RE sources, say by 2040.

dd. By 2025 atleast 25% of the agricultural pump-sets in the country should be shifted from the grid based electricity dependence to either dedicated RE sources or to community based RE sources; the longer term target should be to have 100% of agricultural pump-sets in the country to be powered by RE sources, say by 2040.

ee. By 2015 an effective feed-in-tariff mechanism for roof-top energy systems and community based renewable energy systems should be in place throughout the country to encourage local level energy production;

ff. By 2020 atleast 25% of industries /commercial establishments /hospital establishments /hostels & hotels with heating requirements should be using solar energy for this purpose;

14.6 Global Warming

gg. The carbon tax on coal usage should be increased gradually from Rs. 50 a ton at present to Rs. 500 a ton by 2025 to develop a fund to encourage popularization of distributed renewable energy sources;

hh. A suitably designed pollution tax should be applied to each litre of diesel, litre of water or kWH of energy consumed/generated by 2015; suitable incentive also should be admissible for exceeding the targets of reduction in pollution and efficiency in energy generation.

ii. The available option of revenue earning through Clean Development Mechanism (CDM) in cases of green alternatives to conventional power generations should be optimally used in every state; the option of REDD should be considered for effective implementation;

jj. It will be highly desirable for the Planning Commission to initiate the necessary action to commission an independent expert group to make an objective cost-and-benefit assessment study on all the existing large dam based and coal/diesel/gas based thermal power projects. The group should assess whether these projects have delivered the desired benefits, as also their socio-economic-

environmental impact on the local community. The compiled report should be published and studied so as to reach a final conclusion as to whether such projects have proved to be in the interest of the society, so that the concerns in this regard are satisfactorily addressed satisfactorily by 2020; a similar study on the desirability of nuclear power plants for the country based on feedback from the Civil Society through effective public consultation should be commissioned;

kk. Ecologically sensitive areas such as the bio-diversity rich Western Ghats and West coast, Eastern Ghats and East coast, Himalayas, and other forested areas must not be considered for any power generation/transmission/coal mining activities.

ll. For all hydel projects (including the existing ones) a minimum of river flow (called environmental flow) should be mandated at every point on the river; this quantity should be arrived at by effective consultation with all the stakeholders before 2014.

14.7 Enabling institutional mechanism and other issues

mm. The role of CEA should be reviewed and necessary changes should be brought about to make it's role more people oriented and objective. It should pro-actively interact with electricity companies and the public very frequently on all related issues; conduct state-wise/ region-wise seminars to keep itself up to date with the ground realities; be more sensitive to the environmental and social issues in site selection process etc. In essence it should be a true authority in all aspects of the electricity industry correctly reflecting the needs of the people and bringing the world best practices to India. Instead of being a Delhi based theoretical organization it should become down to earth, people oriented and practical organization. Its staff should be encouraged to gain work experience in generating stations, transmission and distribution systems, and to freely express their opinion on technical and economic issues related to all aspects of power sector.

nn. The mandate for the ERCs should be further strengthened to be able to function independently of the political influence, and in a professional manner. It's functioning should clearly reflect the aspirations of the people while keeping the electricity companies on their toes, but adequately profitable ventures.

oo. Pollution Control Boards have been generally found to be deficient in enforcing the true spirit of the relevant Acts of the parliament/state legislatures. They should also be enabled to function without the influence of the political parties/private companies, and should be made to be truly accountable for the public.

pp. A national fund should invest adequately to reduce the agricultural pump set losses from the present level of about 50 % to below 10 % by 2025; newly created ESCOs may be entrusted with such responsibility;

qq. Public sector autonomy to energy companies to ensure a professional management culture with least possible political interference should be mandated by 2015;

rr. Time bound action plan to formulate legislation for creating two or three time zones for the country should be initiated.

Conclusions

The electric power sector being an inalienable part of the modern life, has also given raise to many serious concerns not only in the Indian context, but also at the global levels. These concerns, which are associated with the social, economic, environmental and intergenerational aspects of our communities, cannot be continued to be ignored any longer. A paradigm shift in our society's approach w.r.t the demand and supply of electrical power has become imperative keeping in view the overall welfare of our huge population.

The STATE, the Civil Society, and the power sector professionals have a duty of care to consider all aspects of the power sector in a holistic manner, and pursue only that course of action which will lead to all-round welfare of our communities, while protecting the flora, fauna and the general environment. Various issues raised in these Chapters, if considered objectively, will lead to such an approach.

ANNEXURES

Annexure: 1

Urban-Rural Discrimination in Electricity Supply

The author, who lives in a village of about 200 houses in Karnataka, experiences such electricity discrimination every day. This village is scheduled to get power supply for 12 hours a day for domestic purpose, but the unscheduled power cuts and other interruptions for maintenance purposes bring this duration down to less than 10 hours a day on an average. On many days the supply situation becomes so bad that even the UPS (Un-interrupted Power Supply) system cannot get sufficiently charged to provide the necessary back up supply for lighting system. The rural feeder at 11,000 Volts which brings supply to the village, like most rural feeders in Karnataka and probably everywhere in the country, is so much neglected that simple devices like lightening arresters are not installed to protect them from lightning surges. The consequence of this neglect is that the sub-station which controls this feeder at Thirthahally town switches it off manually whenever there is an indication of lightning. Being a part of Western Ghats, which receives heavy rainfall during monsoon season, the village is subjected to many such interruptions in a single day, especially during monsoon season. In addition to this there are other types of interruptions which make the electricity supply a farce. Though this village is only 4.5km from the Taluka Head Quarters (Thirthahally) it gets much less power supply than the Taluka Headquarters itself. This situation in Karnataka, where the state capital gets the best quality of supply, and the power quality deteriorates as we go down pop-strata, seems to apply to the rest of the country as well.

Annexure: 2

Taking the Initiative

January 25, 2012

Sierra Club, 85 Second St., San Francisco, CA 94105
www.sierraclub.org

The Carbon Noose Around Asia's Neck

Mumbai, India -- The story is buried in the business section of the Times of India. India's largely government-owned monopoly, Coal India, is changing its pricing system -- and the result will be a staggering 25 percent projected increase in the price of electricity generated with domestic coal. Since imported coal has already tripled in price over the past three years, the reality should be sinking in. An economic development strategy for Asia premised on cheap (if dirty) coal is over.

Even The Economist sees the crisis. The cover of its Asian edition blares "Trouble for King Coal in India." In spite of $60 billion in recent private investment in coal generating plants, India's coal fleet has operated at less than 50 percent of capacity for the past six months -- many plants squeezing through with only a few days worth of coal reserves at a time. Coal production in India has grown -- but at a snail's pace compared with China. Major industrial giants that were financing the enormous fleet of new power plants that this country needs have, effectively gone on a capital strike, suspending plans for 42 gigawatts of new coal capacity. India now produces only 73 percent of its own demand, giving coal exporters like Indonesia and Australia the whip hand and the ability to extract enormous price increases as India competes with other Asian countries seeking to fire their boilers and light their cities.

China has faced the same challenge over the past year. Overheated construction of coal-fired power plants in both countries has caused domestic and Asian demand to outrace supply. That brings expensive, long-distance coal -- its price as much as 60 percent comprised of the cost of embedded diesel fuel required to move it by rail and ship -- into the market. And now low-cost producers, like Indonesia and Coal India, are raising their prices to match soaring international spot prices -- just as low-cost oil producers like Saudi Arabia did with oil in the 1970s.

China has adopted coping strategies drastically different from India's. Domestic coal production has doubled over the last decade.

To no avail. While India faces coal shortages, which yields electricity cuts, China has abundant coal that is too expensive for electricity consumers to afford -- so it too has been running its power fleet at a fraction of capacity, and imposing steep price increases on power consumers.

Myopically, both The Economist and India's government see the solution as somehow forcing more coal out of the ground. A high-level group of business executives met with Prime Minister Manmohan Singh on January 18 and extracted a pledge that the government of India would rush through environmental permit processes that have slowed major coal mining (and other mega projects).

But neither India's nor China's coal reserves are near their major population and industrial centers. So coal (or electricity) must be shipped long distances, and the diesel (or copper) needed to do so ensures that however low worker and environmental standards are placed, coal power will no longer be priced at the cheap 4-5 cents a kilowatt range that Asia is used to -- and was counting on. Instead, any reasonable projection is that except during economic slumps, coal power will cost more like 10 cents -- before cleaning up the pollution it creates. (A new study estimates that coal pollution kills 370,000 Chinese each year, and costs the economy between one and five percent of its total GDP.)

Worse, overreliance on coal is, in effect, driving up India's carbon-imports bill. Either India imports diesel to mine and transport its own coal, or it imports its coal directly. Already, the soaring current-accounts deficit for imported hydrocarbons is an existential threat to the Indian economy. In the U.S., our oil imports bill is a huge drag on our economy -- at $350 billion it is more than half of our trade deficit, 16 percent of the federal government's tax revenues.

But bad as this burden is, it pales in contrast to the stranglehold that imported fossil fuel holds over India. The combined oil and coal imports bill for 2011 soared with higher prices. Relative to India's economy, it is four times as large as the American oil imports drain. And it's heading up. Estimates vary -- The Economist forecasts a two-thirdsincrease, to $165 billion by 2017. Carbon imports already equal two-thirds of all the tax revenues taken in by the Indian government. The population can't afford the prices of imported coal and oil, either. So the Indian government forks out a hefty $23 billion each year in fossil fuel subsidies -- money that is desperately needed for infrastructure and education.

"Yes," the official (as well as most of the private) responses go. Paraphrasing, "Coal is no longer cheap. India can't afford the oil it

imports, much less more-expensive coal. But we have no choice. Nothing else can power our development." Four years ago, with coal power at 3-4 cents, wind at 10-12 cents, and solar at 25-30 cents, that argument made sense. And that perspective -- that coal is the essential, unavoidable path to prosperity --has sunk deeply into Asia's consciousness.

But cost matters, and a largely unnoticed economic revolution has swept Asia's energy markets. Regional coal prices and global copper costs -- the ingredients of fossil power and the grid that transports it -- have tripled. Solar panels and LED lights, however, cost only a third of what they formerly did -- that's a nine-fold shift in relative costs. Today, the marginal kwh of coal power costs upward of 10 cents, wind in China and India costs about seven cents, and solar is already below fifteen cents.

Stringing a wire to a remote Indian village to electrify it costs a staggering $0.02/kwh per kilometer. So just wiring a village ten kilometers from the grid adds a staggering $0.20 to the cost of each coal-fired kilowatt -- about the cost of giving that same village rooftop solar, with the electricity thrown in for free. And even in villages that are already on the grid, 25 percent of India's power is currently squandered operating hugely wasteful and inefficient irrigation pumps at erratic hours. Wind and solar are now cheaper than new coal for India -- but efficiency and energy sector reform are cheaper still.

Between 2001 and 2010, the U.S. almost locked itself into a generation of 180 costly and unneeded coal-fired power plants. Campaigns led by the environmental community, the enacting of state renewable energy standards, and more-abundant competitive sources like wind and natural gas, headed off that almost catastrophic coal rush. Now Asia faces a similar choice -- overbuild coal plants and guarantee bloated prices that will depress its economic potential, or pivot away from reliance on new coal and start deploying the new, low-cost power leaders -- efficiency, distributed generation, wind, and solar.

Will India and China slip the carbon noose in time?

Annexure: 3

Clean Coal Technology

(Source: Wikipeadia AND "Scientific Facts on CO_2 Capture and Storage": http://www.greenfacts.org/en/co2-capture-storage/index.htm)

Clean coal technology usually aims to address only the atmospheric problems resulting from burning coal. But the pollutants emanating from coal burning cannot be eliminated, and hence have to be managed adequately. Concerns exist regarding the economic viability of these technologies and the timeframe of delivery, potentially high hidden economic costs in terms of social and environmental damage, and the costs and viability of disposing of removed carbon and other toxic matter. More, the byproducts of coal power production range from fly ash sludge ponds full of mercury, arsenic, and sulfur in unlined ponds that can leak into the water supply. The coal industry has tried to address the concerns by running advertising touting clean coal in an effort to counter negative perceptions, as well as by putting more than $50 billion towards the development and deployment of clean coal technologies, including carbon capture and storage. The expenditure has been unsuccessful to date in that there is not a single commercial scale coal fired power station in the US that captures and stores more than token amounts of CO_2. The world's first "clean coal" power plant went on-line in September 2008 in Spremberg, Germany. The plant is state owned because of the high costs of this technology. The facility captures CO_2 and acid rain producing sulfides, separates them, and compresses the CO_2 into a liquid state. Plans are to inject the CO_2 into depleted natural gas fields or other geological formations. Some of the largest concerns of this technology are: huge cost implications; an estimated additional energy requirement of about 33% in running the associated processes; uncertainty of keeping the pollutants, including CO_2, deep underground. Some of the techniques that would be used to accomplish lean coal include chemically washing minerals and impurities from the coal, gasification, treating the flue gases with steam to remove sulfur dioxide, carbon capture and storage technologies to capture the carbon dioxide from the flue gas and dewatering lower rank coals (brown coals) to improve the calorific value, and thus the efficiency of the conversion into electricity.

As per IPCC documents it is expected that carbon capture and storage would raise the cost of producing electricity by about 20 to 50%, but there are still considerable uncertainties.

Annexure: 4

Despite Rhetoric, World Bank Fossil Fuel Projects Do Not Contribute to Energy Access

Washington, DC – A new report by Oil Change International, released on the eve of the World Bank's Annual Meetings, dispels the myth that World Bank support for coal and oil projects increases access to energy for the world's poorest. This finding stands in contrast to government, Bank, and industry claims that ongoing taxpayer support for these large coal and oil projects is necessary to alleviate energy poverty.

The World Bank has used arguments around increasing energy access – providing energy to the 1.4 billion people who lack access to electricity or the 2.7 billion still using wood or biomass for cooking and heating – to justify the approval of massive new coal-fired power plants like the Eskom plant in South Africa, as well as the continued funding of oil projects. But both Oil Change International's original research and the Bank's own analysis show that none of the Bank's coal or oil lending for the last two years have prioritized increasing energy access.

"World Bank officials justify massively polluting coal and oil projects by saying that they increase energy access for the poor – but that's just not true", said Elizabeth Bast of Oil Change International. "Our analysis and the World Bank's are remarkably similar. Energy from the World Bank's coal and oil plants go to support big industry, not the world's poorest."

"Once again, the research bears out that the world's poor do not benefit from fossil fuel projects," said Bast. "Not only do the poor suffer the climate impacts of increased fossil fuel emissions and impacts from local pollution, but they are also not receiving the energy from the same projects that damage their livelihoods. With so many in the world without energy, the World Bank must prioritize investments that ensure increased energy access for the poor instead of prioritizing fossil fuel projects for industrial use."

Some key findings from the report, World Bank Group Energy Financing: Energy for the Poor?:

- None of the 26 fossil fuel projects reviewed clearly identify access for the poor as a direct target of the project.
- The World Bank Group and the report authors agree that no coal or oil projects can be classified as improving energy access for the poor.
- In FY2009 and FY2010, funding for upstream fossil fuel projects and fossil fuel power plants dwarfed World Bank spending on access projects by 225 percent or $7.2 billion compared to $3.2 billion for access (according to the Bank's own assessment, which includes two questionable gas projects).

Annexure: 5

Coal-based power plants pollute most

(Source: Magazine "Down To Earth", Dec 12, 2008)

The total installed capacity of the power sector in India is around 128,000 MW. Thermal power plants—using coal, gas or oil—together account for more than 65.6 per cent of the total power capacity in the country

Historically, the Indian power sector has been dominated by coal as the predominant fuel source of power, accounting for 82.45 per cent of the installed capacity followed by gas (16.12 per cent) and oil (1.43 per cent)

India has emerged as the fifth largest power market in the world. It ranked eighth in the last decade

The installed capacity in the sector has increased by more than 70 times from 1,713 MW in 1950 to 128,000 MW in 2007. The National Thermal Power Corporation is India's largest thermal power generating company

According to the power ministry, by 2012, the projected installed capacity of power will be around 207,000 MW, of which around 69 per cent will be contributed by thermal power plants, followed by hydropower (26 per cent) and nuclear (5 per cent). The ministry has also indicated it will double the capacity every 10 years

The western region has the largest share of the installed capacity in coal-based power plants (30.91 per cent), followed by the northern region (25.9 per cent), the southern region (23.3 per cent), the eastern region (19.3 per cent) and the north-eastern region (0.48 per cent)

Among thermal-based power generation sources, coal-based power plants rank highest in air pollution, waste generation and water consumption. It is also the largest emitter of carbon dioxide, a greenhouse gas

A typical 500 MW thermal power plant using coal emits around 105 tonne per day (TPD) of SO_2 (at 100 per cent load factor, 0.7 per cent sulphur content in coal), 24 TPD of NO_2 and 2.5 TPD of particulate matter (at 34 per cent ash content, 99.9 per cent

electrostatic precipitator efficiency) and ash around 3,000-3,500 TPD. Moreover, disposing one tonne of flyash requires around 1 sq m of land

Indian thermal power plants consume on an average 80 cubic metre (m) of water for every MW-hour (MWh), while the global best practice is just 10 cubic m/MWh

Coal-based power plants are one of largest emitters of elemental mercury. On an average, Indian coal-based power plants release around 63 tonnes of mercury every year (assuming 0.25 ppm of mercury content in the Indian coal)

Except for particulate emissions, there are no formal standards for SO_2, NOx and mercury emissions in coal-based power plants.

Annexure: 6

Coal's Assault on Human Health

(Source: Physicians for Social Responsibility, USA)

(http://www.psr.org/assets/pdfs/coals-assault-executive.pdf)

A report of 2009 by the title "Coal's Assault on Human Health" by Physicians for Social Responsibility has elaborately discussed three major categories of human health problems from coal burning. On the vast experience of coal power production in USA this report unambiguously associates many health issues under each category of Respiratory, Cardio-vascular and Neurological problems to coal burning. The report specifically warns of the danger in escalation of complaints of asthma, heart disease and stroke. Some of the major recommendations of the report are: (a) emission of CO_2 should be cut as deeply and as swiftly as possible; (b) there should be no new construction of coal power plants; (c) US should dramatically reduce fossil fuel power plant emission of Sulphur-di-Oxide and Nitrogen Oxides; (d) US must develop its capacity to generate its electricity from clean, safe and renewable energy sources so that existing coal power stations may be phased out.

Annexure: 7

Greenpeace

Extract

The True Cost of Coal – Air Pollution and Public Health

Greenpeace commissioned the Institute for Environmental Health and Related Product Safety under the Chinese Centre for Disease Control and Prevention (CDC) to produce this report, The True Cost of Coal – Air Pollution and Public Health. It aims to present a systematic summary of the most representative cases and to analyze the key impacts of coal combustion emissions on public health, which take into account previous research conducted from various time periods, locations and focus issues. This report aims to deepen and promote a scientific understanding among the public of the health impacts of coal combustion. The report uses layperson's terms and case studies to present this important research in an accessible way.

Shang Qi, Deputy Director
Institute for Environmental Health and Related Product Safety
August, 2010

Summary

1. Coal combustion is one of China's main sources of air pollution. It is the source of 70% of the country's soot emissions; 85% of its sulfur dioxide emissions; 67% of its nitrogen oxide emissions; and 80% of its carbon dioxide emissions. The coal-fired power sector makes up more than 50% of national coal consumption. It is the single largest emitter of air pollutants.
2. The geographic reach of air pollution from coal-fired power plants is considerable. Air pollution can travel distances of up to thousands of km. For example, mercury pollution can travel more than 1,000 km (the distance from Shanghai to Guangzhou) from its emissions source. This means the impacts of air pollution are far reaching.
3. Air pollution from coal combustion can cause long-term or chronic health effects, and as such, they are easy to overlook. They can cause non-specific health problems, such as disturbing normal physiological functions, suppressing immunological functions, and increasing sensitivity to external pollutants. Its impacts are more serious for children, the elderly, those with chronic diseases, and people who are hypersensitive.

4. Although the public is normally exposed to only fairly low concentrations of pollution from coal combustion, some pollutants can be stored in the body's organs and build up over a period of time. Once they reach a critical concentration, they can cause serious adverse health effects.
5. In 2008, 500,000 people in China were estimated to have died from illnesses related to air pollution, of which one tenth were infants.
6. Coal combustion pollution can significantly increase the incidence of respiratory disease. In Taiyaun city, the incidence of cough and excess phlegm among people living near an area polluted by coal combustion was twice as high as the frequency among those living in a control area free from the pollution. The incidence of pneumonia and bronchitis was three times as high.
7. Air pollution from coal combustion can cause a higher mortality rate among the elderly from cardiovascular disease. From research conducted in Shenyang city, for every increase of 50μg/m3 in suspended particulate matter, the increase in mortality from cardiovascular disease among the whole population was 1.22%, while that of the elderly (65 years old and above) was 4.3%.
8. Pollution from coal combustion contain polycyclic aromatic hydrocarbons (PAHs) and other carcinogens. These compounds have been closely linked with lung cancer, the single biggest cause of death from malignant tumours in China.
9. Air pollution from coal combustion can cause an increased incidence of birth defects. Exposure to coal pollution during pregnancy can cause defects in the embryo's nervous system. From our case study in Tongliang township, Chongqing municipality, the concentration of PAHs increased by 3.5 times whenever the coal power station was operating. Exposure to PAHs is linked to an increase in the incidence of babies born with poorly developed nervous systems.
10. The health and economic costs of pollution from coal combustion are considerable. In 2003, air pollution cost the country 157.3 billion yuan in losses associated with premature death and illness (1.16% of that year's GDP). In 2005, every ton of coal burned cost 44.8 yuan in health costs (49% of the environmental cost of coal combustion).

Annexure: 8

Coal Secrets of China

Business Week report in August 2005 says: ”.... most of China's electricity comes from coal power plants but lack effective emissions controls, acid rain falls on one-third of the country. .. Six of the world's 10 most-polluted cities are in China, according to the World Bank, which estimates that pollution costs China more than $54 billion a year in environmental damage and health problems. China's soaring energy use and resulting pollution are a serious threat to the country's continued prosperity and growth, not to mention the well-being of its citizens. China has spent more than $85 billion on environmental cleanup in the last five years and could shell out $380 billion -- 4% of gross domestic product -- between now and 2010. But even those outlays aren't enough to offset the pollution generated by the country's annual growth rate of more than 8%. The problems are compounded by China's inefficient use of electricity, oil, and coal.”

Annexure: 9

Floodwaters welcomed in Indus delta (The Hindu - 07 October 2010)

The Hindu reports that the recent floods in Indus, Pakistan has brought joy and hope for those at the mouth of the Indus river whereas it has caused destruction elsewhere.

The curse of the rest of Pakistan has been a blessing for the Indus delta, a maze of mangroves and shabby fishing villages at the mouth of the 3,000-kilometre river. Here, the fresh water that ravaged the rest of the country is bringing new life and renewal.

Fishermen report an abundance of fish. Catches are up 20 per cent in the last month, and could rise another 50 per cent as the season progressed.

Perhaps more significantly, the floods have brought an ecological windfall. Decades of building irrigation and hydro-electric dams further up the Indus drained the river of its force, allowing salty fresh water to infiltrate the delta. Mangrove plants on the mudflats perished — the acreage was halved between the 1950s and 2009 — while nearby farming land became uncultivable.

Now the swell of fresh water — known locally as " mithi", or sweet water — has injected new life into the sagging ecosystem. The provincial government says the mangroves are growing again as the salt water is pushed back.

A revitalised delta could, in time, turn marshes into agricultural land and herald a return of birds and other wildlife. Keti Bunder, a shabby little port that has been slowly dying over the years, could be revived.

Annexure: 10

Costs and Benefits Analysis - Kotlibhel 1B hydel project

(Source: "Economics of Hydro Power" - Dr. Bharath Jhunjhunwala, Kalpaz Publications)

In a detailed study of costs and benefits of Kotlibhel 1B hydel project in Uttarakhand, Dr. Bharath Jhunjhunwala has meticulously listed a large number of costs to the society. While the project developer (NHPC) of Kotlibhel 1B hydel project has listed the benefits as (i) benefits from generation of power, (ii) 12% free power to State, (iii) employment, lot more costs to the society have been highlighted in this Costs and Benefits Analysis (CBA). Even the benefits mentioned in DPR as prepared by the project developer are not all for Uttarakhand because the additional employment so created will not go to the people of the state alone. It is very important to note that the total benefit and cost of Kotlibhel 1B HEP in this CBA are calculated as Rs.155.5 Crores, and Rs. 931.8 Crores respectively, because of which the resultant economic value of the project can be a net loss of Rs. 776.3 Crores to Uttarakhand and the country. It will be unrealistic to expect the project developer to accept these calculations, but the actual costs to the society can be even higher. Even though different values may be assigned to various costs listed in this CBA by different schools of thinking it is very prudent to consider the magnitude of order in the costs and benefits. Even the staunchest proponent of dam based power projects will find it difficult to support a project which can be associated with a loss to the society of about 6 times that of the benefits. Even if the estimated losses are assumed as only 25% of the indicated value, the costs to benefit ratio will still be 3/2. Such are the costs and benefits to the society of large dam based projects.

Annexure: 11

Costs and Benefits Analysis - Bedthi hydel project

(Source: IISc Website)

One of the first exercises to study in detail the effect of a project on the environment and to develop an economic model imbedding ecological costs has been the study of the Bedthi Hydroelectric Project proposed in Uttara Kannada district of Karnataka in 1980s. This project, proposed across river Bedthi and designed for producing a total of 210 MW, was shelved on the grounds that the economic value of r the biomass generated by the local forest identified for submergence by the dm waters was more than the energy equivalent of the proposed project. It is very pertinent to note that the state government was convinced that economically the project was not a viable one after it was cleared by the Central Government and after all the clearances had been obtained. This project was looked at from economic, ecological and other angles by the scientists from Centre for Ecological Sciences, IISc and other places like IIM (Bangalore), Pune, Calcutta as well as by reputed ecologists and local farming and forestry experts. This study indicated that if realistic cost for forest revenue, agricultural yields, grass and firewood are included in the calculations, benefit to cost ratio comes down to 0.847 from 1.5. If energy storage aspects were to be compared, the project would have produced 1 MW for 50 hectares, whereas the local forests could generate biomass with energy equivalent of 1 MW of power with 25.50 hectares. This clearly illustrated that energy lost could have been more than the energy gained if the project were to be commissioned.

Annexure: 12

BankTrack calls on banks to stop funding nuclear power

Nijmegen, May 26 2010 – BankTrack, in cooperation with a number of working partners, today launches www.nuclearbanks.org, a new website mapping the involvement of 45 leading commercial banks in funding nuclear power projects and companies active in the nuclear sector.

BankTrack considers nuclear energy a grave danger for people and planet. The renewed interest in nuclear energy also poses a severe obstacle to achieving a sustainable solution to the climate crisis -

"Nuclear power covers only a few percent of world energy needs, but it poses massive environmental, health and security hazards. Building more reactors would also be a dangerous waste of time in global efforts to combat climate change: emissions of greenhouse gases have to peak and then significantly decrease in the next ten years, while reactors take a decade or longer to build. Time and resources must instead be used for implementation of renewable energy and energy efficiency measures. In many countries, nuclear policy has become an obstacle to finding effective solutions to the climate crisis and achieving energy security" said Jan Beránek, nuclear energy project leader of Greenpeace International.

"Too many well known banks that otherwise have taken laudable steps towards sustainability, are still investing heavily in the nuclear industry, putting the world on the wrong energy track. Sustainable banking and financing nuclear energy are simply incompatible" said Johan Frijns, BankTrack coordinator.

"Banks need to wake up to the fact that nuclear energy is extremely unpopular with the wider public. For example, a March 2010 European Commission survey found that 52 percent of Europeans consider nuclear power to be a risk for themselves and their families, with only 17 % in favor of increasing the use of nuclear energy. This shows that bank support for this dangerous and dirty form of energy will in the long run alienate many of their customers", said Heffa Schuecking of urgewald in Germany.

Annexure: 13A

High levels estimate of Power benefits for Tamil Nadu from Kudankulam Nuclear Power Project (KKNPP)

	Net (MW: Mega Watts)	Comments
KKNP's capacity: 2 *1,000	2,000	The sanctioned capacity of 2*1,000 MW may go to 4*1,000 MW if the ongoing negotiations with Russia gets to fruition
Average annual power output possible (@ 60 - 80% annual load factor)	1,200 to 1,600	A power plant will not produce at 100% installed capacity at all times. Average annual load factor of the plant is assumed to be 60% though the Kalpakkam power plant (MAPS) has recorded load factor of 40-50% only during last 4 years.
Net average output possible to TN power grid {(Average annual power output) – (Station auxiliary consumption) (@ 10% of power output)}	1,080 to 1,440	10% assumed even though on an average Indian nuclear power plants may consume about 12.5% of the power generated for their own internal use.
TN's share in KKNP (50% of net power output: i.e 50% of 1,080 – 1,440 MW)	540 to 720	TN's share assumed to be 50% from the plant (on the basis of news reports) though the past practice has been to give less than 30% for the home state
Net power available to consumers in TN (after allowing for transmission and distribution losses of 25%)	405 to 540	T&D loss in TN assumed to be 25%, as against national level loss of 25%.
If we also take the inefficiency in end usage of about 20% into account, the net power from KKNP available for productive/welfare usage	305 to 430	As per Prayas Energy Group survey about 20% of the losses in the end usage of domestic appliances are incurred. Losses incurred in industries and agriculture are not taken into account.

Annexure: 13B

Benign alternatives to KKNP available in TN

(as in 2011)

Savings feasible from the existing power network	**MW**	**Comments**
Benefits available by replacing all incandescent lamps in TN	>> 500	It is estimated that the Power savings feasible by replacing all incandescent lamps in the country by CFLs is more than 10,000 MW
Savings feasible by reducing T&D losses in TN from 25% at present to about 10%	1,575	A saving of 15% of 10,500 MW (peak demand met by TN during April 2011 as per CEA report)
Savings due to loss reduction in end usage in various sectors of TN	2,625	Assumed to be about 25% of the actual power demand met, even though the potential for savings may be much higher
Benefits from Renewables		
Wind power	700	Of the total TN potential of 5,500 MW capacity only 4,790 has been realized so far (as per TN energy department's report).
Bio Mass	900	About 900 MW is the estimated potential from bio-mass and bagasse from sugar mills (as per TN energy department's report)
Roof top Solar Photo Voltaic panels (2 kW each on top of 25 lakh houses)	>> 5,000	Assuming 25% of strong and economically sound houses in TN can install solar PV panels of 2 kW each on the roof top
Roof top Solar Photo Voltaic panels and solar water heaters on other buildings	Huge	Schools, colleges, offices, industries, public buildings, commercial establishments etc.

Annexure: 14

"197 suicides and 1,733 deaths at India's nuclear establishments in last 15 yrs"

In an article by rediff NEWS at rediff.com on 4th October 2010 under the above title, it was mentioned that "197 employees belonging to a number of nuclear establishments and related institutes in India have committed suicide and 1,733 scientists and employees belonging to these centres have died of illnesses like multiple organ failure, lung cancer, cirrhosis of liver etc, as per a report compiled by Mumbai-based RTI activist Chetan Kothari." "The report based on 175 pages of documents sourced through 32 nuclear facilicties also reveal that 1,733 employees and scientists from these establishments died due to various illnesses that include cardiac strokes, liver failure, multiple organ failure, tuberculosis, cardio-respiratory diseases, lung cancer, septicemia, cirrhosis of liver, cerebro-vascular dieseases, chronic obstructive pulmonary diseases, mellitus etc amongst a host of other diseases."

"The data has been sourced from the Nuclear Power Corporation of India in Mumbai, Bhabha Atomic Research Centre, Tata Memorial Hospital, Department of Atomic Energy, Atomic Energy Rgulatory Board, Saha Institute of Nuclear Physics (Kolkata [Images]), Uranium Corporation of India (Jharkhand), Nuclear Fuel Complex (Hyderabad), Indira Gandhi [Images] Centre for Atomic Research, Environmental and Industrial safety (Kalpakkam, Tamil Nadu), The Institute fo Mathematical Sciences (Chennai), Department fo Atomic Energy, Heavy Watyer Plant (Tuticorin), Harish Chandra Research Institute (Allahabad), Institute for Plasma Research Centre (Gandhinagar), Institute of Physics (Bhubaneshwar), Heavy Water Plant in Kota (Rajasthan [Images]), Heavy water Pklant, Talcher (Orissa), Raja Ramanna Centre for Advaced Technology (Indore) amongst several others."

Annexure: 15

Vidarbha region to become hot bed of coal power projects ?

(Source: Business Standard of 24 May 2010)

A proposal of setting up 47 new thermal power plants in the backward Vidarbha region of Maharashtra has met stiff resistance from various quarters as it will use up large portion of water in nearby rivers, which have almost dried up due to poor monsoon last year (2009). The proposed generation units will adversely impact the farming community due to huge water consumption from existing water bodies.

The Chandrapur Super Thermal Power Station (CSTPS), which has a total installed capacity of 2,340 MW including 210x4 and 500x3 units, has been facing severe water crisis and six of its power generating units --- three units of 210 MW and three units of 500 MW --- have been closed down due to scanty rainfall last year and non-availability of water from Irai river ....

Maharashtra Water Resources minister, Laxmanrao Dhoble during his recent visit had already warned that 60 pc of the existing power plants will suffer due to water scarcity. Meanwhile, former Union Minister and Nagpur Congress MP, Vilas Muttemwar has taken up the issue of proposed new units in Vidarbha. In a letter to Prime Minister Manmohan Singh recently, Muttemwar pointed out that the Maharashtra government has assured 471.18 Million Cubic Metres of water to the new plants from dam reservoirs, lakes and tanks, obviously by diverting the supply meant for irrigation. Vidarbha is already facing acute shortage of water. Due to lack of irrigation and poor financial plight of farmers, the region has witnessed 40,000 suicides from 1997-2009, Muttemwar said. Also, pollution is a great problem in the region with Chandrapur occupying the third position in the country. Commissioning of more coal fired power plants will not only aggravate the already existing problem, but will also ruin the rich forest cover, he said. The proposal for addition of 20,000 MW power generation by 47 companies is bound to create multiple problems, the minister said in the letter.

"I hence request you to evolve a policy of restricting the concentration of coal based power plants in one particular region to avoid water scarcity, pollution and health hazards." He has sought a direction to the state government to restrict the number of power plants in Vidarbha region. Further, Muttemwar raised the issue in Lok Sabha recently under rule 377 and drew the attention of the government towards it.

Annexure: 16

The case study of an UMPP to demonstrate the relevance of CBA:

Option I: NTPC's proposed UMPP (4,000 MW) at Bijapur, Karnataka

COSTS: Direct Financial Cost: About 32,000 Crores (excluding transmission lines)

Societal Costs + tax incentives

- Cost of about 3,200 acres of low fertile/fertile agricultural land
- Additional land for transmission lines
- Cost of displacement of people
- Cost perpetual loss of agricultural production
- Cost about 5.2 TMC of water; denial of the same to locals
- Infrastructure cost to supply coal PLUS recurring coal cost
- Cost of Air, water and land pollution + Global Warming impacts
- Health costs: respiratory and neurological problems
- Cost of social unrest & economic deprivation of poor people

BENEFITS:

- Average max. power/year from the plant = 2,880 MW (80% PLF; 10% aux. consumption)
- About 1,440 MW (of average maximum power as Karnataka's 50% share)
- Employment for a total of about 500 people? (Indirect employment for about 100?)

Option II: Integrated Energy Management Approach

COSTS (high level estimation only):

T&D loss reduction 2,880 MW >> 5,260 Crores (@2 Crores/MW)
(loss reduction by 9.3%; 31,000 MW demand met in Southern Region 2010-11)

Total cost (a high level approx. cost) ~ 5,260 Crores

BENEFITS:

- Net power of 2,880 MW
- Negligible societal cost; negligible or nil land and water requirement
- Nil displacement
- No recurring costs such as coal, water and chemicals
- Negligible or nil health & environmental costs
- Reduced T& D losses; reduced man power costs

Option III:

IP Set loss reduction - 2,880 MW >> 5,760 Crores
(@ Rs. 2 Crore/MW)

Total cost (a high level approx. cost) ~ 5,760 Crores

BENEFITS:

- Net power of 2,880 MW
- Negligible societal cost; negligible or nil land and water requirement
- Nil displacement
- No recurring costs such as coal, water and chemicals
- Negligible or nil health & environmental costs
- Reduced T& D losses; reduced man power costs
- Boost to agricultural and rural employment

Option IV:

DSM - 1,000 MW >> 2,000 Crores
(Replacement of incandescent lamps by CFLs)

Utilisation loss reduction - 1,880 MW >> 3,760 Crores
(Non-agricultural loads)

Total cost (a high level approx. cost) ~ 5,760 Crores

BENEFITS:

- Net power of 2,880 MW
- Negligible societal cost; negligible or nil land and water requirement
- Nil displacement
- No recurring costs such as coal, water and chemicals
- Negligible or nil health & environmental costs
- Reduced T& D losses; reduced man power costs
  Boost to agricultural and rural employment

Annexure: 17

High level indication of Costs and Benefits of Jaitapur Nuclear Power Project (JNPP) Proposal

(Proposal: 6 X 1650 MWe Reactors @ 200,000 Crores project cost estimation)

	Costs	Benefits	Comments
NPCL Option I	Rs. 200,000 Crores for the main project	Max. power (net) to the Western Region grid = 6,300 MW	- 10% of power goes to auxiliary consumption - about 30% T&D loss in Western Region (WR); PLF = 80%
	Additional land for and cost of transmission lines: 6 * 765 kV lines ??	About 44,000 MU annual energy	@ 80% PLF
	Impact on Agricultural /horticultural production & sales due to radiation fears	Employment for about 500 people?	Export demand for Alfonso mangoes may come down because of radiation contamination fears
	Fisheries production loss		Anecdotal evidence of loss of fishes near Tarapur
	Diversion of agricultural lands for the project		
	Denial of access to thousands of acres of land for grazing; wood and fodder collection		
	Impact on fresh water sources		
	Impact loss on areas of ecologically very high value (bio-diversity hotspot)		

	Costs	Benefits	Comments
Option II			
Efficiency improvement In existing system(T& D loss reduction)	@ 25% of cost of new coal power plant: about Rs, 16,000 Crores	About 8,000 MW max.	T&D loss reduction from 30% to 5% in Western Region; demand met was 32,100 MW in 2009-10
		And about 58,000 MU per year	Available energy in Western Region during 2010-11: 233,000 MU (As per CEA)
		Much better voltage profile in the system	
		None of the other costs of JNPP	
Option III			
(i)CFLs in place of incandescent lamps	Not estimated in detail; but can be less than Rs. 6,000 crores	3,000 MW and 5,500 MU per year	Replacement of incandescent lamps by CFLs in Western region
(ii) Loss reduction in IP sets	Not estimated in detail ;but can be less than Rs. 10,000 crores	3,500 MW and 42,000 MU per year	IP set loss savings can yield about 18 % of the total energy consumption in WR (and at national level); 18% of 233,000 MU
		None of the other costs of JNPP	
Option IV			
(i) PLF improvement in thermal power plants	Not estimated in detail; but can be less than Rs. 12,000 Crores	5,850 MW	Thermal power capacity in WR = 39,000 MW in 2011; increase in PLF from 65% to 80%
(ii) Loss reduction in domestic and commercial uses	Not estimated in detail; but can be less than Rs. 1,000 crores	500 MW	Replacement of inefficient domestic appliances such as fans, TV, refrigerators, water pumps etc.
		None of the other costs of JNPP	

Annexure: 18

Greenpeace announces comprehensive energy strategy for India

(Source: www.greenpeaceindia.org)

Renewable energy, combined with efficiencies from the 'smart use' of energy, can deliver half of India's primary energy needs by 2050, according to the report: 'Energy [R]evolution: A sustainable Energy Outlook for India'. Commissioned by the European Renewable Energy Council (EREC) and Greenpeace it provides a practical blueprint for reducing India's carbon dioxide emissions by 4% in the next 43 years while providing a secure, affordable energy supply. According to the report, the contribution of renewables to the electricity mix needs to be gradually increased from the current 4% to 10% by 2010, 20% by 2020, and 65% by 2050. At the same time energy consumption has to be decreased by implementing energy efficiency measures. Inefficient lighting and other means of wasteful electricity consumption need to be phased out. A Renewable Energy Law needs to be passed creating incentives to stop using coal and oil and invest in renewables instead. It concludes that renewable energies will constitute the backbone of India's economy. More than 30 scientists and engineers from universities, institutes and the renewable energy industry around the world collaborated to provide detailed regional assessments for the future potential for renewable energy sources and energy efficiency measures. The Energy [R]evolution Scenario describes a development pathway which transforms the present situation into a sustainable energy supply, within a single generation. Exploitation of the large energy efficiency potential will drastically reduce primary energy demand. The major Renewable Energy Sources contributing to the electricity production in 2050 will be technologies that are already technically advanced. Solar Photo Voltaic will contribute 25%, Wind 20%, Hydro 11% and Biomass 6%. Large hydroelectric projects that are already established or are in an advanced construction phase will still contribute to Hydroelectric Power in 2050, but as funding of such projects will be discontinued in 2050, small, mini and micro Hydros will contribute to two thirds of the Hydroelectric power. The potential for biomass will be limited to agricultural wastes and the use of wasteland.

Annexure: 19

Time for Plan B: Cutting Carbon Emissions 80% by 2020

Earth Policy Institute, Washington had looked at ways and means of reducing the CO_2 emissions to contain Global Warming. After a detailed examination of the energy resources and the existing technologies available throughout the world, this study has projected the following composition of various electrical energy sources as compared from 2006 to 2020: coal power from 39.9% to negligible; oil power from 6.2% to negligible; wind power from negligible to 38.8%; hydro power from 15.8% to 21.5%; nuclear power from 15% to 11.5%; solar power from negligible to 11.4%; bio-mass from negligible to 5.8%; natural gas from 19.7% to 4.6%; and geo-thermal from negligible to 6.5%. This report highlights the fact that as per the study by International Energy Agency the demand for electricity by 2020 can be reduced below the level of 2006 by ramping up energy efficiency. A global switch to high efficiency lighting would reduce the electricity demand by 12%. Ban the bulb campaign by 9 countries before 2017 has been highlighted. Much emphasis has been given for ramping up power generation capacity through wind, solar, bio-mass and geo-thermal because of low carbon footprint of these technologies. It is very important to note that Earth Policy Institute has come to the conclusion that keeping in view the huge costs involved in disposing nuclear waste, decommissioning the worn out plants, insuring reactors against catastrophic failures building nuclear plants in a competitive electricity market is not simply economical. Plan B energy economy of 2020 will see 90% drop in fossil fuel-generated electricity and five fold increase in renewably generated electricity. This report recognises the need for massive and rapid mobilisation of resources to achieve the goal, but considers it necessary and feasible to view it as a war time emergency.



Shankar Sharma

Shankar Sharma has a bachelor degree (Electrical Engineering) from the University of Mysore, and PG Diploma (Technology Management) from Deakin University, Australia. He has over 31 years of professional experience in the areas of electricity generation, transmission and distribution in India (Karnataka Electricity Board and Central Electricity Authority), New Zealand (Electricity Corporation of New Zealand) and Australia (Queensland Electricity Transmission Corporation). At present he is engaged as an independent Power Policy Analyst, and lives on the bank of river Tunga in Western Ghats. He has been a strong advocate of highest possible levels of efficiency & responsibility in energy usage, and of environmental protection. While trying to practice a simple life style of low energy foot print he is also advocating sustainability in every facet of our society in order to conserve various life-forms on this planet.

He has worked with Greenpeace India in preparing a survey report 'Still Waiting' on the issue of energy injustice, and associated himself with many NGOs in public awareness campaigns on power sector. But he does not identify himself with any particular organization/agency.

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The Coalition for Nuclear Disarmament and Peace (CNDP) is India's national network of over 200 organisations, including grassroots groups, mass movements and advocacy organisations, as well as individuals. Formed in November 2000, **CNDP** demands that India and Pakistan roll back their nuclear weapons programmes. Our emphasis:

- No to further nuclear testing
- No to induction and deployment of nuclear weapons
- Yes to global and regional nuclear disarmament

CNDP works to raise mass awareness through schools and colleges programmes, publications, audio and visual materials, and campaigning and lobbying at various levels.

CNDP membership is open to both individuals and organisations. So if you believe nuclear weapons are evil and peace is important, fill in the Membership Form!

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